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10 **The Water Resources Plan for the Delaware River Basin**  
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13 **October 2003**  
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It is the intent of this Basin Plan to engage all entities with responsibility or interest in water resources – as well as all whose actions affect our water resources – in partnerships for the protection and enhancement and efficient use of water.

*so*

The Basin Plan serves as a non-binding guide to the signatory parties and the Basin community. The Plan does not create any legal rights, nor is it intended to benefit any person or class of persons. The provisions of the Basin Plan are not enforceable against any of the signatory parties, their agencies, political subdivisions, officers, or employees or any other person. This Plan is not an Executive Order or regulation, does not have the force of law, and does not alter any existing legal requirement.

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## Introduction: A Challenge and a Vision

Water flows through every aspect of our lives. We depend on it for transportation, for power, for commerce, for inspiration – indeed, for life itself. Yet too often we take this precious resource for granted, or guard it so jealously for one purpose that we forget its fluid nature. Can we meet the challenge of safeguarding our water resources now and for generations to come? This Plan represents an attempt to meet that challenge, to take into account the many aspects of our water resource and the many needs it must meet, and to weave them into a unifying vision for the Delaware River Basin.

In 1769, a visiting Englishman commented on the “mess” in the Delaware River off Philadelphia – a mess that by World War II had become a stew of toxins that tarnished ships’ metalwork and sickened sailors. The water lacked enough oxygen to support fish and other aquatic life. But the words of the old ballad posed a vexing challenge: To whom did the river belong? Management efforts were piecemeal, driven by conflicting interests over water diversions, dam construction, and fishing rights. It would take the better part of half a century, two Supreme Court decrees, two record droughts and one record flood to bring about a sense of shared ownership of the vital resource that is the Delaware River and its tributaries. (See time line.)

### TO WHOM DOES THE RIVER BELONG?

The lines of the old ballad, “Uncle Sam’s River” pose a challenge as pressing today as when it was composed:

*The river belongs to the Nation,  
The levee, they say, to the State;  
The Government runs navigation,  
The Commonwealth, though, pays the freight.*

*Now here is the problem that’s heavy –  
Please which is the right and the wrong –  
When the water runs over the levee,  
To whom does the river belong?*

**- Douglas Malloch (1877-1938)**

In September 1961, President Kennedy signed the Delaware River Basin Compact, creating the Delaware River Basin Commission (DRBC), and marking the first time in the nation’s history that the federal government and a group of states had joined together as equal operating partners in a river basin planning, development, and regulatory agency. By 1981, the DRBC’s pollution abatement efforts had resulted in a 76 percent reduction in the amount of oxygen-demanding wastes being discharged into the Delaware River estuary, the tidal stretch of the river between Trenton and the Delaware Bay.

Today, the Delaware River supports year-round fish populations, offering excellent small mouth bass, striped bass, and trout fisheries, once again sustained by the water’s oxygen. Marinas are being built on the river’s banks, along with bike trails and parks. As in the past, there continue to be differences on how to manage the watershed. But we have come a long way towards recognizing our common concerns for a common resource. Now it is time to take the next step.

## **A Challenge, and a Vision**

On September 29, 1999, the Governors of the four Delaware River Basin states (Delaware, New Jersey, New York and Pennsylvania) signed a resolution challenging the Basin community to develop a unifying vision: a comprehensive ***Water Resources Plan for the Delaware River Basin***.

**The Challenge:** Water resources planning and management cut across traditional political and programmatic boundaries.

- The Basin covers 13,539 square miles, encompassing parts of four states, 42 counties, and 838 cities, towns, boroughs and townships.
- Just as water is critical to nearly all aspects of our environment and daily lives, many aspects of our lives have an impact on our water resources.

**The Unifying Vision:** In response to the Governors' challenge, the DRBC convened a Watershed Advisory Council. Composed of people representing a wide range of stakeholders, this group has worked together to forge a unifying vision for the Basin, a goal-based plan to guide policy and action to achieve the following results:

- An ***adequate and reliable supply of suitable quality water*** to sustain human and ecological needs into the 21<sup>st</sup> century (2030)
- ***Functional waterway corridors*** that minimize flood-induced loss of life, property and floodplain ecology; preserve natural stream channel stability; provide recreational access; and support healthy aquatic and riparian ecosystems
- ***Integrated management of land and water resources*** to sustain the quality of life in the Basin; preserving, restoring, and enhancing ecological resources while recognizing our social and economic relationships to these resources
- ***Strong partnerships for the integrated management of water resources*** among all levels of government, the private sector, non-governmental organizations, and individuals that have an interest in sustainable water resources management
- ***A shared understanding and appreciation of the Basin's water resources*** and a commitment among all Basin citizens to those resources' restoration, enhancement, and protection.

## **The Purpose of the Basin Plan**

The purpose of the Basin Plan is to provide a unified framework for addressing and redressing new and historic water resource issues and problems in the Delaware River Basin. Toward this end, the Plan emphasizes an ***integrated*** approach: recognizing, for example, that water supply and water quality cannot be managed separately; that ground water and surface water are two aspects of the same resource, separated in time and space, but fundamentally interrelated. Integrated management means considering all aspects of the water resource in decision-making. Conversely, it means recognizing that a wide range of decisions – not just those traditionally associated with water management – can affect our water resources.

This Plan will show how the river that divides us also brings us together. The Basin Plan map (p. X) illustrates this point by assembling the Basin's many watersheds – areas drained by a single waterway or watercourse – into groups, or sub-basins, and by

gathering sub-basins into regions. For example, Camden, Trenton and Philadelphia all are part of the Upper Estuary sub-basin, which with the Schuylkill Valley and Lower Estuary subbasins form the Lower Region of the Delaware River Basin.

The map is useful for characterizing and assessing baseline conditions, prioritizing issues, and for developing regionally and locally specific strategies. Like this Plan, it is meant to help us think outside our traditional political and programmatic boxes, to think, rather, in terms of our **watershed address** – of our relationship to the river, its tributaries and watersheds, and how our plans and actions depend on and affect these resources.

## Organization and Use of the Plan

The Plan is prefaced by a set of **Guiding Principles** against which all policy decisions and actions affecting water resource management should be measured. Many of the Plan's objectives and strategies support more than one goal, but all of them were developed – and should be implemented – with an eye to the Plan's guiding principles. The main body of the Plan is divided into five interrelated **Key Result Areas (KRAs)**. Attention to each of these five areas of concern is essential for the improvement of water resources management. An outcome statement – the **Desired Result** - has been written for each Key Result Area. The structure is:

### → KEY RESULT AREA

#### → GOALS 1, 2, 3...

#### → Objectives A, B, C...

**Naming and numbering:** Goals and Objectives have locator numbers. A Goal is identified by two numbers; the first number is the KRA it belongs in and the second is its own number in the group of Goals associated with that KRA. So, for example, Goal 3.2 is the second goal listed for KRA 3. Likewise, the numbering of Objectives indicates their placement in the Plan. Objective 1.2.F, for example, is objective F for Goal 2 in KRA 1. The number of a Goal or an Objective is for convenience and reference and does not imply any priority or ordering within the Plan.

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## Goals

Goals are displayed as a group and are also discussed individually in a narrative that explains ☒ **Tasks** and ☒ **Challenges** associated with them.

Objectives are displayed in a matrix with milestones, dates, indicators to measure progress and a cross reference of all the Goals with which the Objective is associated, since many objectives relate to more than one Goal.

Objectives	Milestone	Date	Indicator	Supports Goal(s)

Milestones, Dates, and Indicators suggest the timeframes for interim results and means of accounting for or measuring success. Developing meaningful measures of success and timeframes for accomplishing objectives will depend on careful assessment of

conditions and identification of strategies appropriate to physical, political and fiscal circumstances. It will also require the coordinated effort of all partners.

This Plan sets a direction for policy and management decisions over the next thirty years and should be used as a guide for policy setting, decision-making and actions originating from governmental units, private entities and individuals. It forms a framework within which existing and new programs can be incorporated and coordinated for effective results. It also is meant to lead to new areas of research and study to support the achievement of the desired results.

To a large extent this Plan builds on the successes of a variety of existing and ongoing efforts. Paramount among the field is the Comprehensive Conservation and Management Plan (CCMP) for the Delaware Estuary adopted in 1996. The CCMP covers the watersheds in the tidal portion of the Basin, that is the Lower and Bay Watershed Regions (see Map page X). Its pioneering efforts in water quality improvement, habitat protection, and establishing local partnerships form the benchmark for additional work in the Basin.

### **Roles and Responsibilities**

Many of the actions that will be needed to make progress on meeting the Goals and Objectives of this Plan can be taken under the authority already granted to the myriad **federal, state, regional and local agencies, authorities and commissions** that operate within the Basin and its watersheds. These entities are responsible for:

- water quality;
- water supply and provision;
- wastewater planning;
- storm water management;
- environmental resource protection;
- economic development;
- transportation network planning,
- construction and maintenance;
- oversight of development and construction standards; and
- oversight of local planning and growth management.

In addition, there is a host of **non-governmental organizations** whose actions as stakeholders in the Basin complement those of the governmental sector. These include: watershed associations; civic associations and citizen action groups; foundations that support water resource research and protection; academic and research institutions; professional associations; and associations of municipal leaders.

The **Delaware River Basin Commission** plays an essential role in improving coordination and collaboration among these entities. The 1961 Compact granted the Commission broad planning and regulatory powers in the areas of water supply, pollution control, flood protection, watershed management (including soil conservation and fish and wildlife habitats), recreation, hydroelectric power, and surface and groundwater withdrawals and diversions. These powers should be used to educate as



1 well as to regulate; to demonstrate the principles of integrated water resource  
2 management; and to foster partnerships with and among other public and private  
3 entities to achieve the outcomes articulated in the Plan and the collective stewardship of  
4 shared resources.

## 5 6 **Measuring Progress**

7 Much has been accomplished since the initial passage of national and state pollution  
8 control and environmental legislation in the second half of the last century. States have  
9 established environmental protection and conservation agencies, adopted rules and  
10 standards to govern withdrawals from and discharges to their streams and rivers, and  
11 begun developing criteria for the protection of human and aquatic ecosystem health.  
12 Each state has developed programs and priorities, and has made disparate progress  
13 across an array of water resource issues. This Plan attempts to take stock of these  
14 achievements and also to identify the points at which these efforts have fallen short.

15  
16 Existing programs and plans form the foundation of progress already made in the water  
17 resource arena. It is on this foundation that we will build, and from this baseline that we  
18 will measure our progress. Our ability to measure progress toward achieving this Plan's  
19 goals and objectives requires us to:

- 20 1) **assess baseline conditions** to use as a benchmark; and,  
21 2) **monitor and report** those critical indicators which, taken all together, signal the  
22 improvement or deterioration of conditions in the Basin's watersheds.

23  
24 The **watershed** is the locus of our efforts. Positive outcomes will be measured here;  
25 failures will be felt most acutely here. Our quality of life depends on our success.

## 26 27 **The Importance of Integrated Management**

28 The concept of "integrated management" is reiterated throughout this Plan. Like water  
29 itself, managing our water resources must infiltrate everything we do. Viewed in  
30 isolation, the actions we need to take appear to be many and minor. This Plan provides  
31 a framework for understanding the myriad connections – particularly those linking water  
32 and land – and for integrating our actions to achieve a shared vision for the Delaware  
33 River Basin.

### A SHIFT IN EMPHASIS

The history of water resource planning in the Delaware River Basin reflects several major shifts in emphasis:

- Projects...from planning and building major reservoirs and other large-scale projects to attention to stream bank restoration and other small-scale projects intended to restore and enhance the natural functions of our waterway corridors
- Regulation...from no regulation to Federal regulation to regional (e.g., DRBC) and state regulatory policies and programs to an increasingly local project focus
- Focus...from exclusive focus on specific discharges, sites and species to consideration of cumulative impacts, regional planning and ecosystem management, and the linkages among them.

This is not to say that we should not be looking at the “big picture” in planning for the watershed, or that the Federal government has no role to play, or that point source pollution should not be regulated. Rather, these shifts reflect: first, that we have accomplished a great deal already; second, that what remains to be accomplished will require attention to local details with an eye to cumulative outcomes.

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## History of Water Resource Management in the Delaware River Basin

**...May 25, 1931** – US Supreme Court grants New York City the right to withdraw 400 million gallons a day (mgd) from two reservoirs to be built on headwater tributaries feeding the Delaware main stem.

**...Early 1940s** – The four Basin states, Delaware, New Jersey, New York, and Pennsylvania, create the Interstate Commission on the Delaware River Basin (INCodel), an advisory body which establishes water quality standards and begins taking measures to meet them.

**...June 7, 1954** – An amended Supreme Court decree permits New York City to double its withdrawal rate to 800 mgd, contingent on the city's construction of a third in-basin water supply reservoir, and on the city's consent to release from its three upper-basin reservoirs sufficient water to assure adequate stream flows down the Delaware river. (The decree also permits an out-of-basin diversion to central and northeastern New Jersey through the Delaware and Raritan Canal.)

**...July 1955** – The Basin state Governors begin looking at ways to put regulatory muscle behind INCodel, creating a regional body with the force of law to oversee development and control of the river system. The discussion is given further impetus by the worst flood in the Basin's recorded history – a flood that takes 99 lives and leads Congress to direct the US Army Corps of Engineers to develop a comprehensive physical plan for the Basin. The Corps' December 1960 report calls for 58 water control projects to be built over a 50-year period.

**...September 1961** – President Kennedy signs the Delaware River Basin Compact, creating the Delaware River Basin Commission (DRBC), and marking the first time in the nation's history that the federal government and a group of states had joined together as equal operating partners in a river basin planning, development, and regulatory agency.

**...1978-1983** – A record drought during the 1960s, followed by opposition to plans to dam the Delaware at Tocks Island, lead the DRBC to examine alternative ways to provide adequate water supply during droughts. – Five years of deliberations among the 1954 Supreme Court decree parties result in a "Good Faith Agreement" which includes 14 recommendations focusing on drought management through water conservation initiatives.

**...September 29, 1999** – Governors of the four Basin states sign the "Resolution on the Protection of the Delaware River Basin" and requisition a comprehensive water resources plan.

## Guiding Principles

***Ultimately, a water ethic is about sharing – both with nature and with each other.***

~ SANDRA POSTEL 1992: *Last Oasis*

- Water is a precious and finite natural resource, one that is essential to all life and vital to ecological, economic and social well-being.
- The disparate distribution of water resources among watersheds poses a challenge to equitable allocation and use.
- Prudent water management requires a commitment to ecological integrity and biologic diversity to ensure a healthy environment; to a dynamic economy; and to social equity for present and future generations.
- The most effective way to eliminate pollution is to prevent it from occurring.
- Integrated management is crucial for sound results. In making water resource management decisions:
  - Link water quality and water quantity with the management of other resources;
  - Recognize hydrologic, ecologic, social and institutional systems;
  - Recognize the importance of watershed and aquifer boundaries;
  - Avoid shifts in pollution from one medium to another OR Avoid creating a problem in a different location or environmental medium;
  - Push the boundaries of technologic possibility while balancing economic constraints.
- Improved land management is essential for improving the condition of water resources.
  - Decision-making should be based on sound scientific principles and an understanding of the relationship between land and water resources.
  - Effective integrated management requires coordinated planning and action by all levels of government including federal, regional, state, and local levels.
  - Existing planning efforts can provide the foundation for improving land and water resources management.
- Individually and collectively, we are responsible for the stewardship of our water resources through their judicious use and management.
  - An informed public is critical to an improved environmental future.

- Public– private partnerships and enhanced cooperation are necessary for improved results.
  - Successful decision frameworks are flexible enough to encourage and adapt to innovations and new knowledge.
- Existing legal structures and laws provide the framework in which management decisions are made.
  - Decision-making should give due consideration to the policies and requirements in existing laws and the legal rights of persons and entities potentially affected by water management decisions.
  - Authority to make integrated management decisions shall be derived from existing law as applicable, and may entail modifying or enacting new law(s).
  - Legal structures should be utilized that facilitate managing water resources within entire basins, watersheds, and aquifers, rather than on the basis of political jurisdictional boundaries, while continuing to respect the sovereignty of states and their political subdivisions.
  - In water resources management, preferable actions are those that are structured to accommodate and be consistent with:
    - Preservation and enhancement of ecological integrity;
    - Sustainability;
    - Feasibility; and
    - Resilience to natural variability.

A living system exhibits integrity if, when subjected to disturbance, it sustains an organized self-correcting ability to recover toward physical, biological and chemical conditions normal for that system.

~ Based on EPA Terminology Reference System 1997  
[www.epa.gov/trs/](http://www.epa.gov/trs/)

**Actions to be taken to implement the Goals and Objectives of this Plan should be judged against the above concepts and the Guiding Principles.**

## Key Result Area 1: Sustainable Use and Supply

*Water runs like a river through our lives, touching everything from our health and the health of ecosystems around us to farmers' fields and the production of the goods we consume.*

~ PETER GLEICK: *The World's Water 2001-2002*

**Desired Result: An adequate and reliable supply of suitable quality water to sustain human and ecological needs into the 21<sup>st</sup> century.**

***What does this mean?*** We must take an integrated approach to managing our water resources to dependably meet current as well as future human and ecological needs. Integrated management for sustainable use and supply means considering the many fundamentally interrelated aspects of the water resource in decision-making, including:

- Water quality and water quantity
- Surface and ground water
- Demand and supply management
- Environmental, social, and economic dimensions
- Legal dimensions

***Why is an integrated approach important?***

**Water quality and water quantity are interrelated characteristics.**

- Poor water quality affects water supply by reducing the amount of suitable potable water and by increasing the costs of treatment.
- Reduced flows in streams concentrate pollutants and lower water quality, decreasing both the capacity of streams to assimilate effluent and non-point source pollutants, and the suitability of water for downstream users and aquatic life.
- Persistent low flow conditions lead to warmer water temperature, increased nuisance plant growth and algal blooms, and lower dissolved oxygen levels, causing stress and damage to native aquatic communities.
- High flow conditions, caused by increased runoff during storm events, also can affect water quality by increasing bacteria, sediment, salt, pesticide, nutrient, and hydrocarbon loadings from the land.

**Surface and ground water are inextricably linked.**

- Water is a limited resource that is cyclically exchanged between the earth and atmosphere, between soils and streams.

- A portion of the precipitation that infiltrates the soil re-emerges (after only 72 hours, on average) as flow to streams and lakes.
- Maintenance of ground water levels, through the natural process of infiltration and recharge, promotes the maintenance of stream base flows, maintains surface water quality and supports aquatic ecosystems.

**Demand and supply must be in balance.**

- We can reduce demand by using water more efficiently. This includes decreasing system losses, employing conservation behavior and incentives, encouraging technological innovation for increased efficiency, and re-using or recycling water.
- Options to enhance supply include surface storage, conjunctive use, aquifer storage and recovery (ASR), and stormwater management. Soil conservation and wetland protection also contribute to storage potential by maintaining the natural storage capacity of soils and wetlands.

**Environmental and social consequences must be reconciled with economic costs and benefits.**

- Cleaner water in source water streams, rivers and reservoirs requires less treatment, enabling the supply of safe drinking water at lower, more reasonable cost to residents and other users.
- Cleaner water means healthier fish, shellfish and waterfowl, lower risk to public health, and healthier economies.
- Healthy river corridors and waterscapes are aesthetically pleasing. They form a foundation for economically significant recreational activities and add significant dimension to a community's quality of life.

**Diverse legal and regulatory regimes and principles must be coordinated.**

- Historically, common law has dealt separately with groundwater and surface water withdrawals. Sound management requires a regulatory framework that establishes uniform principles for groundwater and surface water and considers the interrelationships between them.
- Stormwater management laws and ordinances generally focus on controlling peak flows during and following development. Yet the volume of runoff and infiltration amounts can also affect stream flows, water quality and ecosystems, and should be part of this focus.
- Laws addressing water quality are distinct from equitable principles governing interstate flow and from state laws governing intrastate water rights. Integrated management involves coordinating these legal regimes.
- The Delaware River Basin Commission, as a regional government agency with authority to manage water resources in the Basin, is best situated to coordinate and promote integrated management throughout the Basin.

## Goals for Sustainable Use & Supply

- 1.1 Equitably balance the multiple demands on the limited water resources of the Basin, while preserving and enhancing conditions in watersheds to maintain or achieve ecological integrity.
- 1.2 Ensure an adequate supply of suitable quality water to restore, protect and enhance aquatic ecosystems & wildlife resources.
- 1.3 Ensure an adequate and reliable supply of suitable quality water to satisfy public water supply and self-supplied domestic, commercial, industrial, agricultural, and power generation water needs.
- 1.4 Ensure adequate and suitable quality stream flows for flow-dependent recreational activities.

### ***Tasks and Challenges***

#### **Goal 1.1: Equitably balance multiple demands on the limited water resources of the Basin, while preserving and enhancing conditions in watersheds to maintain or achieve ecological integrity.**

This is a two-part goal. To **equitably balance multiple demands**, it is essential that we first understand the types of human and ecological demands being made on the hydrological system. This entails the following tasks and challenges.

- ☒ **Assess current water uses** - This essential task encompasses all human uses including wastewater discharges and consumptive water uses. Improving our understanding of water use will help us determine what constitutes efficient use of the resource and what may be deemed essential and non-essential uses.

⇒ The generation of reliable data requires accurate and up-to-date records on all ground water and surface water withdrawal allocations, wastewater discharge permits, and connectivity among withdrawal use and discharge points. Data management problems currently hamper the development of a precise use data set for all watersheds in the Basin. However, existing information for individual watersheds can be used to estimate water use in other watersheds with similar conditions.

- ☒ **Assess in-stream flow and freshwater inflow requirements** - Understanding the needs of aquatic ecosystems is essential to several goals of the Basin Plan. This



task is a prerequisite for assessing the amount of water available for allocation from ground and surface water sources; for setting standards for improving conditions in watersheds and restoring natural functions in stream corridors; for protecting threatened and endangered species; and for improving operating plans for the managed portions of the Basin.

⇒ Prepare and implement scope-of-work to organize research and assessment of in-stream flow needs.

⇒ Additional work may be required to determine the freshwater inflow requirements to estuarine portions of the Basin system.

**☑ Develop strategies for the allocation of water** - Once both human and ecological needs are understood we are ready to address the ⇒ **challenge** of planning to achieve an equitable balance among the multiple demands on the hydrological system. Prudent allocation strategies may include curtailing water uses during drought conditions through allocation decisions or use restrictions, and allocating water to areas with limited water resources as determined by calculated water budgets and availability assessments. Furthermore allocation strategies will need to protect rights of the parties defined in the 1954 U.S. Supreme Court Decree.

The second part of Goal 1.1 is to set realistic goals for preserving and enhancing conditions in watersheds **to maintain or achieve ecological integrity**. This requires a clear understanding of existing conditions, and of the needs of aquatic and riparian populations. Those watersheds that currently approximate natural conditions should be protected to preserve their ecological and hydrological functions and those that have been degraded should be restored or enhanced . This entails the following tasks and challenges:

**☑ Develop tools for assessing ecological integrity.** The development of indices of ecological integrity that integrate the physical, biological and chemical requirements of healthy aquatic and riparian ecosystems is critical for realizing restoration and enhancement goals.

⇒ Determining key species or characteristics that are especially sensitive to changes in water availability or quality is one challenge to be addressed.

⇒ Understanding the relationship of ecoregions, ecological communities and watersheds is integral to the development and application of relevant assessment protocols.

⇒ Setting appropriate criteria and standards for assessment and restoration within the Basin's eco-regions, and for implementing water allocation decisions while

**Goals 1.2, 1.3 and 1.4: Ensure adequate supplies of suitable quality water for:**

- **Aquatic ecosystems and wildlife;**
- **Projected public water supply and self-supplied domestic, commercial, industrial, agricultural, and power generation; and**
- **Flow-dependent recreation.**

Goals 1.2 through 1.4 speak to meeting the water quantity and quality needs of the River Basin for a wide range of uses through the planning horizon of 2030. The tasks associated with Goals 1.2, 1.3, and 1.4 can be grouped under three broad headings:

- A. Assessing needs and projecting demand
- B. Assessing the quantity of water currently available and likely to be available
- C. Ensuring water of suitable quality for the various uses

**A. Assessing needs and projecting demand** for water resources entails many detailed tasks, each with their own challenges.

- ☒ **Identify the freshwater needs for aquatic ecosystems and wildlife.** Aquatic ecosystems and wildlife represent important users of the Basin's waters. Protecting water quality for those uses is an integral part of the Clean Water Act, and of State and DRBC regulations. Fresh water must be available in adequate quantities for drinking, feeding, cleansing and reproduction.

Water availability varies with geographic location and seasonal fluctuations in precipitation and temperature. It is also susceptible to change as a result of the patterns of human settlement and water use. For example, the ways in which water is allocated to uses within and outside of the stream (public water supply, industrial, commercial, agricultural, power production, etc.) and how water is returned to the stream (when, where, in what amounts, and of what quality) can have a great influence on how streams provide for ecosystem needs.

Resilient, healthy ecosystems adapt to changes within a natural range of variability. Changes that push the limits of that range may also cause irreparable harm to communities of water-dependent animals and plants. Therefore, it is important to understand ecosystem function, and the limits to the range of conditions that ecosystems and communities will tolerate.

- ☒ **Project demand for water for various human purposes, including how much, when, and where water will be needed.** Before we can ensure adequate water resources for human purposes into the future, we need to generate projections of population and sector water demand. These projections can then be compared to the water determined (through the water budget and available groundwater assessments) to be allocable – that is, available for use without impairing the ability of the water resource base to support healthy ecosystems.

- 1 ☒ **Project population figures** from the year 2000 Census, aggregated to cover the  
2 basin boundaries as closely as possible, into the future in increments of five or ten  
3 years.

4 ⇒ This will require developing a methodology and range of assumptions to which  
5 the Basin partners are agreeable.

- 7 ☒ **Develop projected water needs for all use sectors**, including estimates of  
8 consumptive use, system losses and the potential effects of various water  
9 conservation programs.

10 ⇒ Projections must take into account possible alternative future conditions. This will  
11 require making not a single projection but a range of projections, reflecting a range  
12 of possible scenarios.

- 14 ☒ Ensuring adequate supplies of suitable quality water for growing populations entails  
15 understanding and managing how and where growth will occur in order to fulfill  
16 expected demand and have the least detrimental impact on natural systems. (See  
17 also discussion of tasks and challenges related to Goal 3.4, p. X.)

18 ⇒ If areas that are water stressed are predicted to grow, then solutions to water  
19 supply problems need to be determined and planned. Lessons learned and legal  
20 constraints established in connection with previous decisions on water transfers  
21 should be incorporated into water resources decision-making in the future to meet  
22 state, regional and local plans for growth management as well as for ecological  
23 needs.

- 25 ☒ **Assess the flows needed for recreational purposes and plan for flow  
26 management.** This task includes several steps:

- 27 • Define the scope of flow-dependent recreational activities to be addressed;
- 28 • determine the needs of these activities; and,
- 29 • set operation strategies to be applied during periods of normal and subnormal  
30 precipitation in the portions of the Basin where flow releases are managed.

32 ⇒ Legal restrictions on the use of stored water should be examined. This analysis is  
33 likely to be undertaken as a separate task from the quantification of in-stream flow  
34 needs for ecological integrity.

36 **B. Assessing the quantity of water that is currently available and likely to be  
37 available in the future** requires the calculation of water budgets for watersheds within  
38 the Basin.

40 A **water budget** is a description of the fate of water resources in a watershed, as  
41 illustrated in Figure X. Budget “inputs” include precipitation and imports (transfers into  
42 the system). Water inputs will become:

- 43 • evapo-transpiration (ET) into the atmosphere,
- 44 • direct flows to surface water bodies (runoff),
- 45 • indirect contributions to stream flow through the soil and the water table,

- recharge to deeper groundwater aquifers,
- consumptive losses associated with human use; and/or exports from the watershed.

The proportion of water inputs that arrive at each destination is determined by climate; by geology, soils and topography; by the land use attributes of a watershed; and by the way in which we use water resources. Water budgets yield an average annual accounting of water volumes and do not reflect seasonal variation. Although the water budget approach has limitations, a pilot study is currently underway as part of a USGS-DRBC partnership to assess the feasibility of using water budgets as a screening tool for watershed assessments.

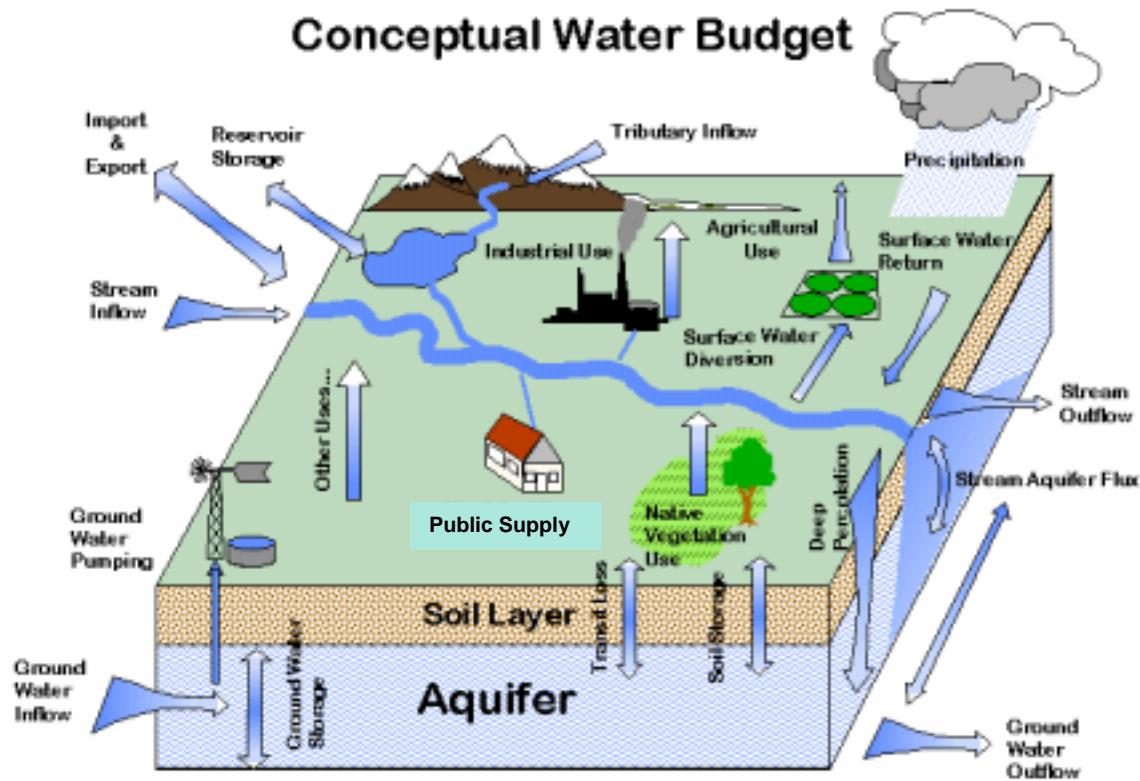


Figure X: Illustration courtesy of: Colorado Division of Water Resources, Office of the State Engineer

- ☑ **Calculate water budgets** on a realistic scale. The issue of **watershed scale** is important (see box). USGS has assessed ground water availability for sub-basins within the Pennsylvania Ground Water Protected Area, but implementation of this Plan will require a methodology sanctioned collectively by the Basin states for determining ground and surface water availability.
- ⇒ Complete development (already underway) of a methodology to be applied basin-wide.

1

### DEFINING THE APPROPRIATE SCALE FOR CALCULATING WATER BUDGETS

The Natural Resource Conservation Service classifies watershed units by Hydrological Unit Code (HUC). The Delaware River Basin includes 236 watersheds classified as HUC 11. These average about 55 square miles in size. By contrast, there are only twelve HUC 8 watersheds delineated by USGS for the Basin. However, these may be too large for the purpose of developing water budgets. Smaller units (HUC 14 scale) number in the thousands, creating a practical barrier to developing a Basin-wide coverage of water budgets at that watershed scale in the short-term. However, knowledge of watersheds at smaller scales may be appropriate for local planning purposes, for assessing impacts, and for supporting restoration efforts.

2

3 **C. Ensuring water of suitable quality** means making sure that water quality meets or  
4 exceeds the needs of its intended use.

5

6 ☒ **Assess existing water quality.** Determine the actual concentration of a water  
7 constituent at an in-stream site or sites, through field measurements and laboratory  
8 analysis of data collected over a period of time to adequately reflect the natural  
9 range of hydraulic and climate factors which affect water quality.

10 ➡ This requires a commitment of time and resources since information needs to be  
11 collected for a duration sufficiently representative of the natural variations or  
12 changes in natural systems that can be expected to occur.

13

14 ☒ **Periodically monitor conditions.** Water quality conditions must be monitored with  
15 sufficient frequency in the main stem and the tributaries to reveal a trend of quality  
16 maintenance, improvement, or degradation.

17 ➡ Developing a realistic and integrated view of the Basin's water quality and taking  
18 the necessary steps to ensure it requires strong coordination and cooperation  
19 among Basin partners. Specifically, Basin partners must be able to coordinate  
20 monitoring efforts, agree on methodologies and criteria for sampling and  
21 assessment, and agree on the advice to be provided to water resource users.  
22 Coordination and cooperation is necessary to conserve fiscal and staff resources  
23 and provide adequate and reliable data. Ultimately, it will determine the quality and  
24 consistency of the water quality information collected and used in the Basin.

25 ➡ Building on existing monitoring and indicator programs, the challenge will be to  
26 determine robust sets of indicators for each of the objectives in this Plan.

27

28 ☒ **Maintain good water quality.** One of the most important tasks we face, this will  
29 require setting and agreeing on permitting standards for discharges as well as  
30 providing tools and information that will prevent additional impacts from non-  
31 regulated land development and management activities. Approaches may include:

- 32 • **Anti-degradation programs** (e.g., state protections for high quality and  
33 exceptional value streams, the DRBC's Special Protection Water  
34 designations and federal Wild and Scenic Rivers designations);

- **Stormwater management programs;**
- **Water quality-based trading programs** (another means of achieving “no measurable change” in quality by offsetting impacts from new or expanded discharges by equivalent reductions from other sources within the watershed).

⇒ We face a major challenge to “keep our clean water clean” in areas where we expect increases in growth and development activity in the future.

- ☑ **Improve water quality.** Where standards are not being met for designated uses, we must develop regulatory and non-regulatory programs to identify pollutant sources, and develop a strategy to achieve the standards. An important regulatory program is that of assigning Total Maximum Daily Loads (TMDLs) to the water body when levels of pollutants in the water body exceed standards. Other approaches can be used. For example, a trading program might be used to more cost-effectively meet standards through trading between existing point and non-point sources.

⇒ Vigilant monitoring and development of innovative strategies to mitigate potential new impacts will be necessary to keep water quality from further impairment.

⇒ Take steps to ensure “fishable” waters. Fish bio-accumulate certain chemicals and toxins in their flesh. When accumulation reaches levels higher than those deemed safe for human consumption, States post health advisories against eating even limited amounts of certain species from specified water bodies or stream segments. In addition to the implications for human health, the quality and abundance of fish species in the Bay and its tributaries support the commercial and recreational fishing (and associated tourism) sectors. Developing stormwater management programs for existing development is one strategy for improving water quality. See also Goal 2.3, Key Result Area 2: Waterway Corridors and Goal 3.2, Key Result Area 3: Integrating Land and Water Resource Management.

⇒ Allocating pollutant loads for discharges and non-point sources resulting in upgrades to treatment facilities and the use of best management practices (BMP) with water quality controls is another strategy.

1

Objectives	Milestone	Date	Indicator	Supports Goals:
<b>GOAL 1.1 BALANCING USE AND ECOLOGICAL INTEGRITY</b>				
1.1.A. Develop an integrated resource management strategy to determine amount of water available for allocation considering: <ul style="list-style-type: none"> <li>Water budget</li> <li>In-stream flow needs</li> <li>Groundwater availability</li> <li>Assessment tools</li> <li>Degree of hydrologic/biologic disruption</li> </ul>	Methodology, Pilot studies completed.  Assessment tools developed.  Budgets completed for all watersheds at appropriate scale.	2004  2006  2006 <del>7</del>	Use of tools in policy evaluation	1.1, 1.2, 1.3, 4.2,
1.1.B. <b>Assess the biologic and hydrologic integrity</b> of watersheds and integrate the criteria into water allocation strategies.	In-stream flow needs established. Criteria developed  Natural hydrograph established at appropriate scale.  Ecological needs incorporated into reservoir operations and allocation decisions.	2005  2006  2008	Improvement of monitored biologic and hydrologic criteria	1.1, 1.3, 1.4, 3.1, 3.2, 4.2
1.1.C. Discourage and where necessary manage any <b>expanded or future transfers of water and wastewater into or out of the Basin</b> to minimize and mitigate environmental or other negative impacts, while giving consideration to feasible alternatives, the water needs of the sending basin, and the efficient use in the receiving basin of available resources.	Criteria developed for evaluating interbasin transfers.	2006	Environmental and other negative impacts of interbasin transfers minimized.	1.1, 1.2, 1.3, 1.4, 2.3, 4.1
1.1.D. <b>Assess existing transfers of water and wastewater in to or out of the Basin</b> in light of changes, such as new water resource management strategies, technologies, storage, planning, and/or demand.	<u>Include as part of docket, permit review, etc.</u>			
1.1.E. Manage <b>future and expanded transfers of water and wastewater among watersheds</b> to minimize and mitigate environmental or other negative impacts, while giving consideration to	Guidelines developed for balancing needs among	2010	Watersheds accommodate planned growth with	1.1, 1.2, 1.3, 1.4,

Objectives	Milestone	Date	Indicator	Supports Goals:
feasible alternative, the water needs of sending watershed and the efficient use in the receiving watershed of available resources.	watersheds.		minimal environmental impacts.	
1.1.F. <b>Assess existing watershed transfers of water and wastewater</b> in light of changes, such as new water resource management strategies, technologies, storage, planning, and/or demand.	<u>Include as part of docket, permit review, etc.</u>			
1.1.G. For <b>future droughts</b> ensure the equitable allocation of water supplies for essential domestic, commercial, industrial, power generation, and agricultural uses, while maintaining ecological integrity of aquatic ecosystems.	Agreement on formulas for water use curtailment during droughts	2005	Reduced environmental and economic severity of drought impacts	1.1, 1.3, 1.4, 4.1,
<b>GOAL 1.2 MEETING ECOSYSTEM NEEDS</b>				
1.2.A. Integrate <b>in-stream flow and estuary fresh water inflow requirements</b> for the support of healthy aquatic ecosystems into water resource regulations and decision making.	Criteria developed and adopted into allocation and operation strategies	2004 - 2010	Improvement of monitored biologic criteria	1.2, 1.3, 2.2, 2.3, 3.1
1.2.B. <b>Where water quality meets or is better than standards</b> for the protection of fish and wildlife resources, implement anti-degradation regulations, policies and/or other mechanisms to maintain or improve existing water quality	Agreement on necessary anti-degradation measures.	On-going	No measurable degradation of water quality	1.2,
1.2.C. <b>Where water quality</b> is not sufficient to protect aquatic <u>and wildlife</u> , employ strategies to provide <u>lifestage</u> protection through the implementation of TMDLs and other regulatory and non-regulatory means.	Meet TMDL schedules  Develop criteria <u>protective of wildlife</u>	varies  <u>2006</u>	Improvement in parameters of concern;  <u>Improvement in metrics for aquatic &amp; wildlife health</u>	1.2
<del>NEW 1.2.D. Where water quality is not sufficient to protect wildlife uses, employ strategies to provide protection through the implementation of TMDLs and other regulatory and non-regulatory means.[combined with above]</del>				
<b>GOAL 1.3 MEETING OFF-STREAM NEEDS</b>				
1.3.A. For normal hydrologic conditions ensure supplies for projected public and self-supplied domestic, commercial, industrial, agricultural, and power generation demands <u>through 2030</u>	Water use projections completed. Agreement on strategies to	2006	Assured availability under normal conditions.	1.1, 1.2, 1.3, 1.4, 4.1



Objectives	Milestone	Date	Indicator	Supports Goals:
	meet future need			
1.3.B. Plan under drought of record conditions, to provide adequate supplies for projected public and self supplied domestic, commercial, industrial, agricultural, and power generation demands through 2030.	<u>Water use projections completed.</u> <u>Agreement on strategies to meet future need</u>			
1.3. <b>BC</b> . Ensure <b>maximum feasible efficiency</b> of water use across all sectors, prioritizing efforts based on the existence of watershed transfers and/or substantial consumptive use; including promoting water conservation technology and habits, leak detection and repair, pricing incentives, etc.	Set efficiency measurements by sector.		Measurable and improved efficiency of water use.	1.1, 1.4
1.3. <b>CD</b> . Increase the <b>beneficial reuse and recycling</b> of reclaimed water.	250 mgd (or need to be determined based on projected demand.)	2020	Increase in beneficial reuse	1.1, 1.3, 1.4
1.3. <b>DE</b> . Where <b>water quality meets or is better than standards</b> for the protection of drinking water, implement anti-degradation regulations, policies and/or other mechanisms to maintain or improve existing water quality.	Agreement on necessary anti-degradation regulations	ongoing	No measurable degradation of water quality	1.3
1.3. <b>EE</b> . Where <b>water quality does not meet standards</b> for the protection of drinking water, employ strategies to achieve standards through the implementation of TMDLs and/or other regulatory and non-regulatory means .	Meet TMDL schedules	varies	Improvement in parameters of concern	1.3
1.3. <b>FG</b> . Protect the quality of public and industrial water supplies by preventing the <b>isochlor</b> from exceeding 180 ppm at river mile 98.	No salinity impacts to public and industrial users.		Salinity @ RM 98	1.1, 1.2, 1.3
<b>GOAL 1.4 MEETING RECREATIONAL NEEDS</b>				
1.4.A. Integrate consideration of <b>flow regimes</b> to support water-based recreation in the River and tributaries into allocation and management decisions.	Recreational flow needs quantified	2005	Improved flows for water-based recreational activities.	1.5, 2.2
1.4.B. Where <b>water quality meets or is better than standards</b> for the protection of recreational uses, implement anti-degradation regulations, policies, and/or other mechanisms to maintain or improve existing water quality.	Agreement on necessary anti-degradation regulations	ongoing	No measurable degradation of water quality	1.4
1.4.C. Where <b>water quality does not meet standards</b> for the protection of recreation uses, employ strategies to achieve standards through	Meet TMDL schedules	varies	Improvement in parameters	1.4

Objectives	Milestone	Date	Indicator	Supports Goals:
the implementation of TMDLs and/or other mechanisms.			of concern	

1  
2  
3

***The Nation behaves well if it treats natural resources as assets which it must turn over to the next generation increased, not impaired, in value.***

~ THEODORE ROOSEVELT

## Key Result Area 2: Waterway Corridor Management

*It is impossible to step into the same river twice.*

~ HERACLITUS 535-475 BC

**Desired Result:** Waterway corridors that function to minimize flood-induced loss of life, property and floodplain ecology; to preserve natural stream channel stability; to provide recreational access; and to support healthy aquatic and riparian ecosystems.

**What does this mean?** We recognize that our waterway corridors – streams, rivers, lakes, and their adjacent, interdependent landscapes – serve multiple functions. We must therefore integrate our efforts to manage these corridors as:

- Natural resources for conveying flood waters
- High quality waters for safe recreational enjoyment, and as cultural and historical amenities for our communities
- Habitat for diverse and productive biological communities

### WHAT IS A WATERWAY CORRIDOR?

A waterway corridor is a stream, river, or lake, and the portion of its adjacent landscape that directly affects and is affected by its hydrology and ecology. The Basin's waterway corridors connect to create networks, enabling a variety of species to migrate between aquatic and terrestrial environments, and from one region of the Basin to another.

### **Why is an integrated approach important?**

Traditionally, our approach to managing waterway corridors has tended towards single-issue programs: wetland protection, stream encroachment limits, structural flood reduction projects, regulation of flood plain development, and site-specific recreation and access projects. As we have come to better understand the multiple functions waterway corridors serve, we must strive to incorporate this understanding into our decision-making.

**The natural function of waterway corridors is to convey flood waters, transport sediment, and minimize erosion.**

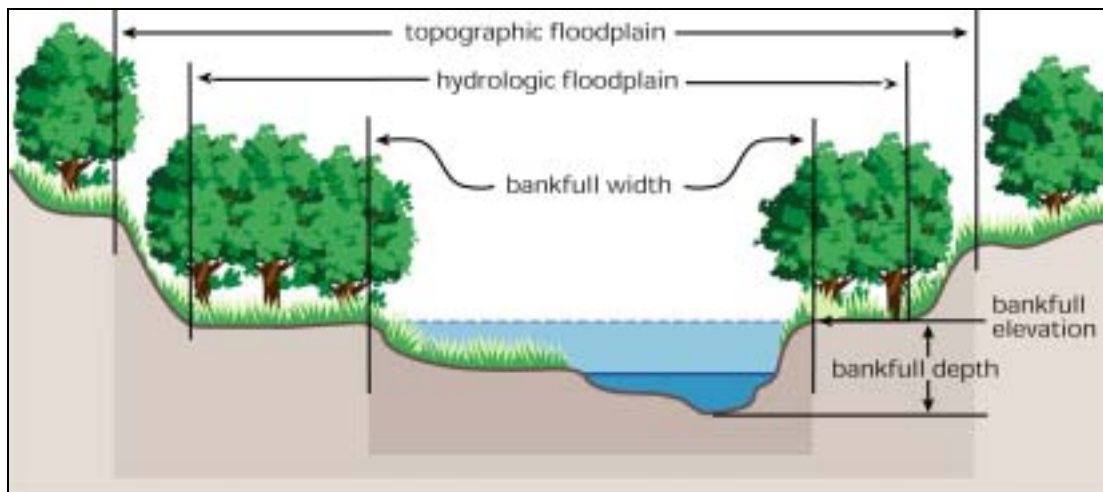
- Flooding occurs in all watersheds and along coastal areas.
- In undeveloped watersheds, while it may be temporarily damaging, flooding provides benefits to the ecosystem and is part of natural hydrological variability. Flood waters carry mineral-rich sediment, which when deposited on the banks, improves soil productivity.
- In developed watersheds and flood plains, flood damage is primarily due to the placement of structures and human activities within an area that is

susceptible to flooding. Changes in land cover within a watershed frequently increase this area.

- Building occupied structures within a floodplain ensures vulnerability to flood hazard, property damage, and potential loss of life. Existing floodplain development has made adequate flood warning a priority in order to provide lead time for emergency actions to prevent loss of life and property.

**The Basin's waterways are important recreation venues as well as community amenities.**

- Rivers and lakes of the Delaware River Basin are located within a day's drive of about 20 percent of the U.S. population.
- Recreational activities range from passive (such as wildlife or landscape photography) to active (hiking, fishing, trapping, hunting, canoeing, boating, white-water rafting). They include activities along the waterways as well as on or in the waters themselves.
- Waterway use is dependent on adequate public access along the streams, rivers and the Bay.
- The Basin includes National Wild and Scenic Rivers, the Appalachian Trail, and numerous game lands, parks, and forests that can be linked to optimize a recreational experience.



Cross-Sectional Illustration of a Waterway Corridor (from Stream Corridor Restoration: Principles, Processes, and Practices. Federal Interagency Stream Restoration Working Group (FISRWG) 1998)

**Waterway corridors provide essential aquatic and riparian habitat.**

- Waterway corridors function as transportation networks and food sources for wildlife, and provide habitat for shelter and propagation for aquatic and terrestrial species of plants and animals.
- Forested buffers provide temperature control, keeping the water cool and shaded from sunlight. This helps maintain more constant environment for temperature-sensitive species, and stabilizes dissolved oxygen levels.
- Vegetated riparian zones provide woody debris that serves as a refuge for aquatic species. Vegetation also helps to stabilize stream banks, reducing erosion and minimizing disruption to aquatic habitats..
- Adequate freshwater flows to estuarine wetlands are necessary to maintain required salinity levels and habitats for estuarine species.
- Excessive high flows and inconsiderate recreational use can physically impair waterway corridors, threatening the health of natural ecosystems.
- Making our waters “fishable” means creating an aquatic environment supportive of healthy fish and wildlife, as well as having finfish and shellfish safe for human consumption.

**MULTIPLE FUNCTIONS CALL FOR AN INTEGRATED APPROACH**

- streambank and channel restoration as well as streambank re-vegetation to establish channel stability during flood flows
- floodplain and stormwater management to maintain natural patterns for detention, infiltration, and recharge, and to minimize changes to the rate at which runoff reaches a stream
- protecting the floodplain as a means of providing the sediment and nutrient transport needed by the waterway corridor system
- linking the naturally vegetated corridors to provide habitat and safe travel for wildlife

## Goals for Waterway Corridor Management

- 2.1 Prevent or minimize flood-induced loss of life, property and floodplain ecology.
- 2.2 Enhance water-based recreation in the River and its tributaries.
- 2.3 Protect, conserve and restore healthy and biologically diverse riparian and aquatic ecosystems.

### ☑ **Tasks and ⇨ Challenges**

#### **Goal 2.1: Prevent or minimize flood-induced loss of life, property, and floodplain ecology.**

Achieving this important goal requires significant efforts in several areas.

- ☑ **Assess flood hazards.** - Identifying areas and structures within a community that are at risk is the single most important step in mitigating future flood damage and loss. Recently released federal guidelines lay out a thorough process for characterizing and assessing those risks. This includes more generalized methods that can help communities plan to prevent structural loss. Flood hazard information must be made available to communities so that they can identify structures at risk and develop mitigation plans.
- ☑ **Develop pre- and post-development mitigation strategies.** The Disaster Mitigation Act of 2000 requires that all municipalities and states develop hazard mitigation plans to remain eligible for post-disaster mitigation grants.
  - Pre-development strategies may include floodplain and stormwater regulations and property acquisition along stream corridors.
  - Post-development strategies include a range of options from elevating a structure above flood level to removing the structure entirely from the flood hazard area, either through relocation or buy-out, demolition, and streambank restoration.

⇨ The practice of removing stormwater from a site as quickly as possible, or controlling only its peak flow rate but not its volume, combined with the extensive clearing of forested land that historically precedes human settlement, has altered the hydrology of many watersheds in the Basin, severely in some instances. The importance of stormwater management to reduce both ecosystem and property damage, along with steps to improve our current system of management, is explained in greater detail in Key Result Area 3: Land and Water Resource Management.

- 1 ☒ **Enhance flood forecasting.** No matter  
2 what assessments and mitigation  
3 strategies are implemented, adequate  
4 warning about impending or potential  
5 flood events remains key to minimizing  
6 loss of life in flood events. Accuracy  
7 depends on hydrological forecasting  
8 capabilities.

9 ➔ Implement the “*Recommendations to*  
10 *Address Flood Warning Deficiencies in*  
11 *the Delaware River Basin*,” prepared in  
12 May 2002 by the Delaware River Basin  
13 Commission with technical guidance  
14 from the DRBC Flood Advisory  
15 Committee.

- 17 ☒ **Educate decision-makers.** Community  
18 leaders, residents and developers need  
19 to be educated about the natural functions of waterway corridors in flood mitigation,  
20 the risks that accompany inappropriate development in the floodplain, and the need  
21 for hazard mitigation and stormwater management plans to mitigate hazardous  
22 conditions and prevent them from occurring. (See KRA 3, Goals for stormwater  
23 management; and KRA 5, Goals for increasing awareness and stewardship.)  
24

- 25 ☒ **Take steps to minimize the ecological impacts of floods.** Landscape alterations  
26 that occur with human settlement include intrusions into the floodplain – structures,  
27 roads, bulkheading, and the filling of wetlands – intrusions which can interfere with  
28 both watershed hydrology and the floodplain’s ability to convey water (see box).  
29 This rapid and damaging erosion and  
30 deterioration of stream channels, and the  
31 associated ecological consequences, can be  
32 minimized through a combination of  
33 responsible development decisions,  
34 stormwater and floodplain management, and  
35 wetlands preservation.

- 36 ☒ **Link flood control and stormwater**  
37 **management.**

38 ➔ Coordinating flood mitigation and  
39 stormwater management involves a vast array  
40 of agencies, departments, offices and  
41 programs at all levels of government. A more  
42 detailed assessment of this challenge can be  
43 found in KRA 4: Institutional Coordination and  
44 Cooperation. The box to the right presents a  
45 generalized list of the range of entities

#### HOW DEVELOPMENT EXACERBATES FLOOD IMPACTS

Flood waters that would be retained in the headwaters or allowed to spread into the floodplains are quickly transported on the conduits of paved roadways or in storm sewer pipes directly into the waterway. Overburdened with flood water, the water gains speed and power, picks up sediment and debris and rushes down waterways too constricted by development to function properly. This increases scour on the sides and bottom of waterways, uprooting plants, and eliminating substrate for bottom-dwelling species.

#### FLOOD & STORMWATER MANAGEMENT

- Federal and State Emergency Management Agencies
- Army Corps of Engineers
- EPA and State Depts of Environmental Protection
- Dept of Agriculture and Soil Conservation Districts
- County Planning agencies
- Local planning and zoning commissions
- Building code officials & State licensing programs
- Local departments of public works
- Municipal engineers
- Environmental commissions
- Watershed associations



involved in some way with these policy areas.

**Goal 2.2: Enhance water-based recreation in the River and its tributaries.**

The Basin includes National Wild and Scenic Rivers, the Appalachian Trail, and numerous game lands, parks and forests that can be linked to optimize a recreational experience. Several initiatives are critical to meet this Goal.

- ☑ **Create a Delaware Basin recreation use and access plan.** - The need exists for regional recreational use and access planning that provides for overall integrated management of recreation and tourism, protects water resources from recreation impacts, provides enjoyment and convenient access, and protects the health and safety of recreational users. A basin-wide recreation and tourism focus group is forming to review recreational objectives and develop a plan that includes strategies to:

- promote the Basin as a tourist destination;
- provide additional public access to waterways;
- create a linked water trail system;
- increase of the scope and frequency of stream and river trash collection;
- maintain or improve recreational water quality and avoid impacts from recreational use; and
- improve the connections of communities to their waterways.

⇒ The streams and rivers of the Basin are attractive and natural transportation routes, yet are often isolated from one another, are located on or very near private property, or lack access sites or safety features.

⇒ Hazards abound near urban areas, in the vicinity of dams, and where high-speed roads and railroads share space with recreational users. Few amenities are available to travelers along water corridors.

⇒ Inconsiderate recreational use can degrade environmental quality, especially through physical impacts to sensitive riparian ecologies. Challenges lie in understanding thresholds and, where necessary, setting limits to human use.

- ☑ **Coordinate efforts to expand access and enhance the recreation experience of the river-using public.** Numerous entities in the Basin are involved in providing recreation and tourism services, yet regional connections are lacking: between towns along waterways; between user and provider communities; and between states.

⇒ Implementation of recreation and tourism objectives will require a serious coordination effort.

- ☑ **Promote visual and physical access to waterways in community development plans.** This will require concerted efforts to educate developers, officials, and the public about the opportunities waterway corridors can offer for recreation, and the need to promote access through local planning.



- 1
- 2 ☒ **Develop operating plans for reservoirs that take into account their various**
- 3 **functions.** Public and private water storage facilities, or reservoirs, serve a variety
- 4 of important purposes, including public water supply, power generation, flow
- 5 augmentation and flood control. They also provide recreational opportunities (both
- 6 at the facilities and downstream). Facility functions may be prescribed by statute
- 7 and/or subject to regulatory approvals of the Delaware River Basin Commission, the
- 8 Federal Energy Regulatory Commission or other agencies, and their operating
- 9 plans must reflect their various functions.

10

11

12 **Goal 2.3: Protect, conserve, and restore healthy and biologically diverse riparian**

13 **and aquatic ecosystems.**

14 The health of natural plant and animal communities requires that flows in fresh water

15 rivers and streams exhibit the natural range of variation in the flow regime, especially

16 seasonally. Other physical and chemical parameters are also critical to the health of

17 ecosystems. Understanding the range of needs for the diverse native aquatic and

18 riparian populations within the Basin is a challenge in itself. Managing waterway

19 corridors to support the health of these natural communities requires, at minimum,

20 addressing the following tasks and challenges.

- 21
- 22 ☒ **Define water flow and quality criteria to support diverse and abundant aquatic**
- 23 **and riparian communities.** Ecosystem needs for flow and for water quality vary
- 24 seasonally with life cycles of aquatic and riparian species.

25 ⇒ Defining criteria is dependent on topography, elevation and geology and specific

26 to the collection of populations in a region, a watershed or a stream's reach.

- 27
- 28 ☒ **Establish fresh water inflow requirements for estuarine ecosystems** in the tidal
- 29 portion of the Basin. Present policy consists of meeting a flow target for the
- 30 Delaware River at Trenton, NJ. The target is designed to maintain the 30-day
- 31 average chloride concentration at or below 180 ppm at river mile 98 during
- 32 repetition of drought-of-record conditions to be protective of industrial and potable
- 33 supply needs. Currently a model is employed to forecast salinity changes based on
- 34 projected changes to the flow regime

35 ⇒ Up-to-date information on climate change and sea level rise should be used

36 when evaluating projected estuary conditions.

37 ⇒ Freshwater inflow needs of estuarine systems need to be established and

38 incorporated into scenario evaluation.

- 39
- 40 ☒ **Incorporate ecosystem requirements in establishing water quality criteria and**
- 41 **flow targets for ambient waters, stormwater and other discharges.** The Basin
- 42 states are using biological and physical criteria in addition to traditional chemical
- 43 criteria for assessment and protection of aquatic life and there has been increased
- 44 monitoring of biological assemblages, habitat conditions, stream morphology, and
- 45 riparian conditions to determine overall ecological integrity of the Basin's waters.

⇒ Improve coordination and cooperation among agencies and non-governmental organizations to effectively assess and manage the Delaware River and its tributary watersheds, including the setting of water quality criteria in a coordinated manner to support consistent designated uses throughout the Basin. Ideally, these criteria will not just be the minimum acceptable for the survival of adults, but support and protect all life stages and the reproduction of aquatic and riparian communities.

☑ **Employ restoration techniques to improve impaired waters or maintain the ecological functions of waterways and riparian lands.** Some forms of restoration are simple, such as removal of dams to improve water quality and fish passage in streams, and to prevent disruption of floodplains and riparian zones. Other restoration and protection measures are very complex, such as protection, replacement or restoration of wetlands, riparian forests, modified stream channels, and flow regimes. These will require large investments in research and agency support, but they can be successfully accomplished in the near future with major benefit to water resources.

⇒ Environmental restoration is a fairly new field, and information needed to determine objectives and predict ecological response to restoration measures is sparse. After 300 years of modification to the Basin's landscapes and waterways, restoration is presently as much an art as a science, and will remain so without coordinated and sustained regional cooperation.

**Take steps to protect riparian and aquatic ecosystems.** Important game species thrive on a food base of non-game mammals, birds, fish, reptiles, amphibians, mussels, and invertebrates supported by the Delaware River.

⇒ Identify and protect the habitat and life stage requirements of key commercial, recreational, game, non-game, threatened, and endangered species so that they survive and successfully reproduce throughout their natural ranges.

⇒ Implement invasive species management. Competition from invasive species is second only to habitat loss in its impact on ecosystem integrity. Identifying invaders, their means of distribution, and means of controlling them offers a tremendous ecological and economic challenge.

1

Objectives	Milestone	Date	Indicator	Supports Goals
<b>GOAL 2.1 PREVENT OR MINIMIZE FLOOD-INDUCED LOSS</b>				
2.1.A. Upgrade and modernize <b>flood warning &amp; forecasting</b> capabilities.	Completion of work plan steps as outlined in report: <i>Recommendations to address Flood Warning Deficiencies</i> , May 2002.	2010	Online availability of Advanced Hydrologic Prediction Service (AHPS)	2.1
2.1.B. <b>Characterize flood damage risks</b> , prioritize and implement actions to reduce risk and losses, and address human induced ecological impacts of hydromodification.	<p>Completion of state &amp; county flood mitigation plans.</p> <p>Completion and adoption of flood mitigation plans for all Basin communities.</p> <p>Integrate flood mitigation and stormwater management in watershed communities.</p>	<p>2005 - 2010</p> <p>2010</p>	<p>Compliance with Disaster Mitigation Act of 2000</p> <p>Removal of streams from <u>impaired list (303(d))</u> for <u>reasons of</u> hydro-modification.</p>	2.1, 3.4
<b>GOAL 2.2 ENHANCE RECREATION</b>				
<p>2.2.A. Develop a <b>recreational water use &amp; public access plan for the Basin</b> that provides for :</p> <ul style="list-style-type: none"> <li>Increased public access, and</li> <li>Improved recreational experiences for all users, through signage, guides, provision of destination points, linkage to other recreational opportunities, etc.</li> <li>Increased availability of pump-out facilities, etc.</li> </ul>	Basin-wide Recreation Plan developed, with regional segments.	2006	Basin-wide Recreation Plan 2005-2030	2.2

Objectives	Milestone	Date	Indicator	Supports Goals
2.2.B. Develop identified <b>recreational facilities</b> and amenities per Basin-wide Recreation Plan.	25% facilities & amenities completed	2010	Increased recreational use of waterway corridor amenities.	2.2
2.2.C. Create a continuous <b>network of water trails</b> for the river, tributaries and lakes.	25% of trail network completed.  Trail network completed.	2010  2020	Continuous network of water trails along tributaries, connected to main stem	2.2
2.2.D. Reduce or prevent generation of debris and trash and expand clean up programs in river and tributaries.	10% per year increase in debris collected  10% annual increase in volunteer river cleanup programs	establish baseline 2005	Ongoing programs adequately staffed and funded.  No unsafe conditions on river and tributaries.  No flood damages due to debris	2.2, 5.2, 5.4
2.2.E. Develop an <b>inter-state campaign to promote the Basin as a recreation and tourist destination.</b>	Strategy developed to promote assets defined in the Basin-wide Recreation Plan.	2007	Recreational assets of the Basin promoted.	2.2
2.2.F. Ensure that <b>recreational uses do not impair</b> the ecological integrity of aquatic <u>and riparian</u> ecosystems.	Recreational impacts identified.  Recreation impacts reduced by 25%.	2006 baseline  2008	% reduction in pollution inputs  Low-impact construction & practices manual  Recreational BMP manual	2.3, 1.2

Objectives	Milestone	Date	Indicator	Supports Goals
2.2.G. Support and encourage watershed communities to <b>incorporate water-based recreational assets in planning</b> and management, including requirements in subdivision ordinances.	Workshops provided for public officials and building industry.  Requirements such as public access included in local ordinances.	2005  2010	Increased recreational access and support for local waterway corridor use and protection.	2.2, 3.5
<b>GOAL 2.3 PROTECT &amp; RESTORE ECOSYSTEMS</b>				
<del>2.3.A. Protect, enhance and restore aquatic and terrestrial plants, animals and habitat to <b>sustain balanced ecosystems and viable commercial and recreational fisheries.</b> [much like Goal 2.3]</del>	<del>Define critical habitat and food sources.  Set criteria for protection and restoration.</del>	<del>2015</del>	<del>Locally optimal measures of diversity, richness, balance, abundance, integrity and resilience.  Locally optimal measures of habitat.  Robust recreational and commercial fisheries.</del>	<del>2.3</del>
2.3.A. Implement <b>conservation plans</b> for populations, assemblages and communities of indigenous aquatic and terrestrial plants and animals. Consider habitat needs for water quality and availability, reproduction, food supply and refuge from predation.	<u>Define critical habitat and food sources.</u>  <u>Set criteria for protection and restoration.</u>  Plans developed for key species or communities.	<u>2015</u>	<u>Locally optimal measures of diversity, richness, balance, abundance, integrity and resilience.</u>  <u>Locally optimal measures of habitat.</u>  See DELEP.	<u>2.3</u>

Objectives	Milestone	Date	Indicator	Supports Goals
2.3. <del>BA</del> (2). Implement <b>fisheries management plans</b> to sustain commercially and recreationally important species of the Basin.	Targets met for plan for key species: shad, oysters, horseshoe crabs, etc.	Dates per management plans.	Indicators per relevant management plans in place. <u>Robust recreational and commercial fisheries.</u>	<u>2.3</u>
2.3. <del>BC</del> . Increase the quality, diversity and function of <b>wetlands</b> throughout the basin.	Set assessment criteria; baseline 2004. Watershed based assessments of wetland function, protection and restoration opportunities.	2006	X% increase in functioning wetland acres, 2006 baseline, by 2030.	2.3, 3.3
2.3. <del>CD</del> . Implement strategies to <b>protect critical riparian and aquatic habitat</b> .	Critical habitats identified, mapped and prioritized. Protection & restoration strategies developed and adopted.	2006 2008	X% increase in critical habitat protection and restoration by 2030.	2.3
2.3. <del>DE</del> . Implement <b>invasive species management</b> throughout the Basin	Management plans developed.	2006	Plans implemented 2008	2.3
2.3. <del>E-F</del> . Improve the <b>beneficial use of dredged materials</b> in habitat restoration.	Plans developed.	2008	Plans implemented. Habitat increased.	2.3
2.3. <del>F-G</del> . Prioritize and remove <b>impediments to fish passage</b> .	5% increase in miles/acres of streams opened to migratory species, such as River herring	2006	Maximum stream miles without impediments.	2.3

Objectives	Milestone	Date	Indicator	Supports Goals
2.3. <del>G-H</del> . <b>Stabilize stream channels</b> based on systemic analysis of causes of instability	Identify areas of instability and causes. Prioritize restoration opportunities in a watershed framework.	2006	Miles of streams with natural stability.  X% increase over 2006 baseline.	2.3, 2.1, 3.3

## Key Result Area 3: Linking Land & Water Resource Management

***Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our water is the principal measure of how we live on the land.***

~ LUNA LEOPOLD

**Desired Result:** The integrated management of land and water resources to sustain the quality of life in the Basin; preserving, restoring and enhancing ecological resources while recognizing the community's social and economic relationships to these resources.

***What does this mean?*** Water is a finite resource, one that is necessary for all life and upon which our social and economic structures are dependent. Efficient water use and improvements in water quality can be attained only by linking land development and management practices with water resource considerations. To achieve the most efficient, protective and sustainable use of those water resources, our growth and development decisions must reflect the following:

- that water is a flowing medium;
- the interconnectedness of land and water; and
- the watershed as the natural framework for integrating water resource decisions.

***Why is it important to integrate the management of land and water resources?***

**Water is a flowing medium, connected to the land on which it falls and the soils it infiltrates.**

- Water flows through soil and fractures in rock as well as over the landscape on its way to water bodies above and below the land surface.
- Our environmental protection experience has shown us that focusing on the point sources of pollution, through "end-of-the-pipe" regulations and standards, while very successful, is not enough.
- To achieve and maintain water quality that is sufficient for all the uses of the Basin's waters, we must attend to the non-point sources of pollution, those diffuse sources that are distributed across the landscape.
- We may need to amend our development patterns and land practices to make more efficient use of water resources and to maintain the function of



landscape elements that are integral to the quality and abundance of water resources.

**The interconnectedness of land and water must be incorporated into our decision-making.**

- An integrated approach to water resource management and protection recognizes that water resources function in a cyclical and dynamic system, one of constant exchange through biological, chemical and physical processes between land and sky.
- The interconnectedness of land and water resources has been accepted by science for decades, but quantifying some of the relationships remains a challenge.
- Failing to incorporate the interconnectedness of land and water into our decision-making, we will continue to make decisions that have unwanted environmental consequences.

***Experts tell us that water management is best done on a watershed or basinwide basis. This requires all who have a stake, whether in or outside government, to join in developing approaches tailored to regional needs.***

~ MADELINE ALBRIGHT, 2000 Earth Day speech on  
*Global Water Security in the 21<sup>st</sup> Century.*

**The natural framework for integrated decision-making is the watershed.**

- The dynamic, cyclical exchanges between water and land have global patterns, but are most readily experienced and understood on a *watershed* basis.
- Recognizing that water resources are naturally cycled within a watershed, the challenge becomes incorporating the watershed unit into our community, regional and state-wide decision-making structures.
- Given the natural and political constraints confronting the development and implementation of a “watershed plan,” integrating water resource considerations into existing decision-making processes is the most efficient way to achieve the goals and outcomes of this Plan.
- Since the vast majority of land management decisions, both public and private, are made at the local community level, this Plan focuses on integrating water resource considerations at the level of the ***watershed community***.

- Engaging local communities in watershed-based planning requires each community to acknowledge its respective role as an “upstream” and a “downstream” steward, and to coordinate with other communities in the watershed and with partner agencies and organizations to engage in a unified effort to use and to protect water resources.
- Community plans and ordinances should be revised and adopted to reflect common watershed goals for water resource and growth management.

#### WHAT IS A WATERSHED COMMUNITY?

A **watershed** is the landscape that drains into a water body such as a stream or river. Unfortunately, political divides, patterns of commerce and transportation, and even groupings of similar ecological communities do not necessarily fall within watershed boundaries. For the purposes of this Plan, a **watershed community** encompasses the residents, landowners, businesses, voluntary associations and governmental units that make decisions about resources and development within a given watershed area. Members of each watershed community are both “upstream” and “downstream” stewards of their portion of the watershed.

### Goals for Linking Land and Water Management

- 3.1 Preserve and restore natural hydrological cycles in the Basin's watersheds.
- 3.2 Maintain and restore the integrity and function of high value water resource landscapes.
- 3.3 Fully integrate water resource considerations into land use planning and growth management.
- 3.4 Encourage development and redevelopment in areas where growth can improve the economic viability of local communities while providing for the protection and enhancement of the water resources of the Basin. Discourage development and redevelopment where it may impair water resources and their related natural resources.
- 3.5 Physically and visually emphasize and strengthen the social, historic, cultural, recreational and economic connections of communities to the Basin's waterways.

### **☑ Tasks and ⇨ Challenges**

#### **Goal 3.1: Preserve and restore natural hydrological cycles in the Basin's watersheds.**

From absorption into the atmosphere as a gas, to the eventual recharging of lakes, streams, rivers, estuaries and aquifer systems, the natural hydrological cycle is a continuous and dynamic process in equilibrium. Human disruption alters the cycle in many ways. Mitigating these disruptions requires us to address land development practices and regulation, as well as impacts from existing development.

- ☑ **Approximate natural seasonal flow regimes.** In addition to gauging water budgets on a reasonable watershed scale, as discussed in KRA 1, we need to establish a desired hydrograph of storm flow intensity over time to be approximated through stormwater management.
- ☑ **Preserve soil health for infiltration and recharge to support base flows.** Disturbance or removal of soil inhibits infiltration and, if the remaining soils are compacted, may even prevent recharge from reaching water supply aquifers.
- ☑ **Maximize natural vegetation.** Vegetation helps to maintain soil stability and local temperature regimes (microclimates). The removal of vegetation reduces soil stability, increasing soil erosion and sedimentation in waterways. The removal of vegetation also alters the amount of evaporated and transpired water to the atmosphere that normally occurs during photosynthesis. Loss of vegetation increases localized temperatures – the *heat island effect* that is further exacerbated by large amounts of paved surfaces. Not only is the protective shade of streamside

vegetation lost, the stormwater runoff from paved, unshaded surfaces has a higher temperature to which native stream species may not be tolerant.

- ☑ **Replicate the natural timing and volume of stormwater runoff to ensure recharge volumes equal to those of natural conditions.** We interrupt infiltration by routing runoff from paved areas directly into waterways. This can result in flooding, severe erosion, and temperature and quality changes.

A lack of appreciation for the natural hydrological cycle can sometimes take us to the other extreme as well. For example, wetlands play an important role in the water cycle and in habitat provision. Some landscape preservation programs prohibit stormwater from being discharged into wetlands in an effort to maintain water quality. Unfortunately, in trying to maintain water quality for habitat, we run the risk of starving wetlands, which, after all, need water to survive..

### **Goal 3.2: Maintain and restore the integrity and function of high value water resource landscapes.**

Certain elements of the landscape are integral to the maintenance of water resource quality and quantity. Depending on existing local conditions, these landscape elements play specialized roles in water cycling and renewal.

- ☑ **Inventory landscape elements within each watershed that play a critical role in water cycling and renewal.** (See box for a suggestive list of elements.)

⇒ High value water resource landscape elements should be identified at the watershed level. Steps to retain their hydrological function must be made where land use, development, and preservation decisions are made.

#### **WHAT ARE HIGH VALUE WATER RESOURCE LANDSCAPES?**

This list is meant to be suggestive, not all-inclusive, as each watershed may contain a set of elements, or additional elements, that perform uniquely within that watershed. Each element may be defined in terms of the attributes associated with it:

- *Wetlands* – soils, hydrology, vegetation
- *Erodable slopes* – geology, soils, slope
- *Floodplains* – areas subject to flooding within waterway corridor
- *Groundwater recharge areas* – soils, geology
- *Headwater streams* and associated drainage area.
- *Potential and existing public water supply sources* (surface and groundwater)
- *Forested areas* associated with headwaters and water supply areas.
- *Water bodies* and their associated riparian corridors, habitat and floodplains.

- 1 ☒ **Incorporate the location and functional importance of high value water**  
2 **resource areas or landscapes into natural resource inventory elements of**  
3 **local and county plans.** These elements are important in the local establishment  
4 of optimal land use and density, for local and regional landscape protection efforts –  
5 such as open space planning – and for setting performance standards for  
6 development and management practices to be required during development  
7 reviews.  
8
- 9 ☒ **Include plans and performance standards in local zoning and development**  
10 **ordinances.** Local ordinances should incorporate plans and standards to ensure  
11 and enhance the water resource function of key landscape elements.  
12  
13

14 **Goal 3.3: Fully integrate water resource considerations into land use planning**  
15 **and growth management.**  
16

- 17 ☒ **Aggregate and analyze information about the following topics on a watershed**  
18 **basis:**
  - 19 • Water availability and capacity of water supply systems, including the protection  
20 of stressed or threatened source waters;
  - 21 • Availability and capacity of wastewater treatment;
  - 22 • Stormwater management to preserve and restore natural hydrological function;
  - 23 • Capacity of hydrological systems to assimilate point and nonpoint sources of  
24 pollution;
  - 25 • Direct and indirect impacts to natural systems;
  - 26 • Maintenance of the function of high value water resource landscapes; and the
  - 27 • Recreation potential of waterway corridors.
- 28 These topics should be used to plan and manage community and regional growth.  
29

- 30 ☒ **Adopt an integrated approach to considering water supply availability.** An  
31 example of water supply availability considerations might include, but not be limited  
32 to:
  - 33 • Have the watershed communities developed surface or groundwater supply?
  - 34 • To what extent is conjunctive use of ground and surface water possible?
  - 35 • Is there a current or projected water supply deficit, and if so, what will be the  
36 impacts of transferring water into the watershed?
- 37 The latter point raises further questions about the intended use of the water:  
38 What water quality impacts could occur from its direct use and discharge? What  
39 indirect impacts can be expected from stormwater runoff, landscape alteration, and  
40 associated land management practices? How can these impacts be avoided or  
41 lessened? (See also, KRA 1 discussion of water availability and growth  
42 management.)

1  
2 ☒ **Coordinate the planning of water supply in conjunction with wastewater management and growth/land use planning.** Typically, water supply planning is  
3 accomplished independently of wastewater planning. Sewer service decisions that  
4 are made independent of land use decisions may have undesirable consequences.  
5 To plan growth wisely, a service provider needs to work with watershed  
6 communities to plan for managing new development.  
7

8 ⇒ Many utility decisions for water and wastewater supply are made through utility  
9 commissions or boards that are not connected to community planning or to other  
10 agencies with interests in utility provision.

11 ⇒ Coordinated planning for wastewater treatment and growth management should  
12 include strategies to sustain the resource base.

13  
14 ☒ **Consider capacities of watershed systems when permitting projects and when planning for the future.** Local water bodies become the recipients of  
15 wastewater discharges and stormwater runoff. Understanding an ecosystem's  
16 natural limits and linking these to water and land management is important, both for  
17 wastewater and stormwater planning, and for setting realistic goals for  
18 development. Just as communities and regional agencies consider the capacity of  
19 water and wastewater treatment plants and transportation networks, these entities  
20 need to consider the assimilation capacity of the watershed's hydrological systems.  
21 Alternatives to direct discharge to water bodies, and establishment of water quality-  
22 based discharge standards are existing tools that can protect water resources.  
23  
24

25 ☒ **Consider direct and indirect impacts to natural systems.** Where and how water  
26 is withdrawn, used and discharged directly affects natural hydrological systems.  
27 Prudent planning should consider these direct impacts as well as indirect impacts  
28 such as:

- 29 • increases in stormwater volume and changes in quality from increasing the
- 30 amount of impervious surface;
- 31 • water quality impacts from maintenance activities, such as the application of de-
- 32 icing agents on roads and parking lots or fertilizer or pesticide applications for
- 33 agricultural activities, golf courses, and other recreational fields;
- 34 • lowering of ground water tables and impacts to streams and wetlands resulting
- 35 from increased pumping for irrigation or for potable supply.
- 36

37 ⇒ These issues are all linked directly to land development, although they are not  
38 necessarily integrated into planning and project permitting processes.  
39

40 ☒ **Establish what is known about local conditions and linkages by compiling an environmental inventory.** Our ability to accurately quantify local hydrological and  
41 ecological systems is limited by available data, a lack of modeling tools, and by  
42 fiscal resources. However, potential impacts can be identified based on known  
43 relationships and considered in planning scenarios even if advanced models are  
44 lacking.  
45

⇒ Failure to identify potential impacts based on known, albeit non-quantified, linkages can have serious implications for a community's water resources in the future.

**Goal 3.4: Encourage development and redevelopment in areas where growth can improve the economic viability of local communities while providing for the protection and enhancement of the water resources of the Basin.**

**Discourage development and redevelopment where it may impair water resources and their related natural resources.**

Our choices about where we develop, how we develop, and how we manage our activities on the landscape, affect the quality and availability of water resources. Smart choices for growth and development incorporate water resource protection, emphasized in Goals 3.1, 3.2, and 3.3; seek to use fiscal resources efficiently; and acknowledge the historic roots of a community as well as its current and future social and cultural needs. Forces for growth and development must be channeled to provide smart choices. Governmental agencies, in partnership with private profit and non-profit organizations, can develop financial and regulatory incentives to encourage smart choices for growth, development and redevelopment that do not harm and can benefit water resources. We need to enable smart choices through the following actions:

- ☑ **Examine impacts and develop plans on a watershed, aquifer or regional basis.**
- ☑ **Identify targeted areas for redevelopment** to absorb growth where supporting infrastructure already exists or could be improved.
- ☑ **Cluster new development** to provide a mix of uses and activities, minimizing transportation impacts well as landscape alteration.
- ☑ **Return contaminated sites and other brownfields** to productive use and remove them as a source of surface or ground water contamination.
- ☑ **Adopt ordinances and regulations designed to protect water and support natural resources through performance standards.**
- ☑ **Incorporate natural features as functional design elements**, e.g., linking constructed and natural wetland systems for stormwater and wastewater management.
- ☑ **Educate policy-makers, decision-makers and developers** about water resources, the benefits they provide, and their community enhancement potential.
- ☑ **Restore the visual and physical connections of people to the waterways at every opportunity.**

**Goal 3.5: Strengthen connections of communities and people to waterways.**

Waterway landscapes appeal to all of our senses. Our history and culture are tied to our waterways. Our progress as a society has depended on water for transportation, for power, for commerce, and for poetic and artistic inspiration. Unfortunately, many of us take water for granted, possibly because we're disconnected from it.

☒ **Provide the opportunity for experiencing our waterways.** Experience is the foundation for education, and education is a foundation for stewardship. Yet many of the natural opportunities for experiencing the waterways have been lost: drinking water comes from a pipe or a bottle; our urban streams have been filled in or enclosed; shorelines have been developed, blocking access and views; floodplain and wetlands environments have been unrecognizably altered.

⇒ Re-establishing the connection to our waterways is critical not only to the protection of water resources, but to the maintenance of some of the best aspects of human culture.

⇒ How we re-establish connections must be context-appropriate; e.g., re-establishment of flood plains where practical; re-establishment of access and visual connections where suitable, especially in redevelopment opportunities. In urban areas, it means re-developing abandoned and decaying waterfront areas with a requirement that all projects include elements designed to restore our physical and sensory connections to the waterfront.



**LINKING LAND AND WATER RESOURCES MANAGEMENT...**

... is central to the success of this Plan – in that it involves all aspects of water resource and land management, of cooperation and coordination, of landscape considerations, and of education for stewardship. Integrating water and land management challenges us to:

- Understand the physical, chemical and biological water-land connection that defines a watershed;
- Recognize the management strategy options necessary to achieve positive water resource and development outcomes;
- Improve communication and planning within the watershed community;
- Improve regional coordination among water resource and land use agencies;
- Create public, non-profit and private partnerships;
- Employ incentives to foster stewardship;
- Improve our collection, analysis and distribution of water resource information;
- Develop and use analytical tools for local and regional decision-making;
- Commit state, regional and local entities to engage in and support growth management and resource protection on a watershed basis.
- Commit financial resources to support and coordinate local and regional planning and water resource protection efforts.

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Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
<b>GOAL 3.1 RESTORATION OF HYDROLOGIC INTEGRITY</b>				
3.1.A. Encourage and support <b>land use designs that maintain pre-development response to storm events</b> with respect to infiltration and runoff volume, velocity, and quality.	Watershed-based stormwater management plans developed and adopted that: - maximize infiltration while avoiding ground water mounding - minimize site disturbance.	2006	Streams and surface waters are less impacted from storm events. Floods, stream blow-outs and sedimentation are minimized. Stream baseflows are maintained or enhanced. Water quality improvements realized.	3.4, 1.2, 1.3, 2.1, 2.3
3.1.B. <b>Remediate adverse effects from existing land use practices</b> , based on prioritized impacts to watershed impairment or water quality	Criteria developed for land management practices.  Watersheds evaluated and prioritized for remediation efforts.	2005	Targeted watersheds receive priority funding for mitigation of existing impacts.  Water quality improvements in remediated watersheds.	3.4
3.1.C. Discourage land use and stormwater management practices that exacerbate <b>hazardous conditions</b> , i.e. sinkholes, flooding, etc	Identify areas especially vulnerable to impacts from development (e.g., karst geology).  Standards established to protect areas and prevent hazardous conditions.	2005  2006	Watershed communities adopt consistent protection standards.	3.4, 2.1
<b>GOAL 3.2 WATER RESOURCE LANDSCAPES</b>				
3.2.A. <b>Map high value water resource areas</b> (HVVRA) and assist watershed communities and stakeholders in prioritizing these resources for protection or special management.	All HVVRA are identified and ranked for Basin and watersheds.  Priority areas	2005  2010	Functions of HVVRA are maintained.	3.3, 2.1, 2.3, 4.1, 4.2

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
	protected in plans and ordinances.			
3.2.B. <b>Develop guidance</b> for performance standards that protect the function of High Value Water Resources.	Functional performance standards established for HVWRA .  Ordinances and regulations include performance standards for HVWRA.	2006  2010	(Note: Performance standards may differ from state to state and among regions of the Basin.)	3.3, 4.2, 2.1, 2.3, 4.1, 4.2, 4.4
3.2.C. Encourage and assist watershed communities and stakeholders to <b>prioritize HVWRAs for land preservation programs.</b>	Landscapes of water resource value identified and prioritized for protection.  High value areas included in land preservation programs.	2006  2010	Watershed communities protect valuable water resource landscapes.  Number of regional and local Open Space & "Friends" programs	3.3, 4.1, 4.2, 4.4, 5.2, 5.3, 5.4
3.2.D. Utilize information from <b>source water assessment</b> programs in prioritizing protection efforts to minimize contamination threats to drinking water supplies.	Protection efforts funded and implemented	2006	Drinking water sources less vulnerable to contamination	3.1, 3.3, 1.3
<b>GOAL 3.3 WATER RESOURCE CONSIDERATIONS AND LAND USE PLANNING</b>				
3.3.A. Develop a <b>basin-wide watershed assessment</b> , defining priority issues, to help watershed communities identify water resource issues that should be considered in land use plans and ordinances.	Watershed assessments completed with available data.  Issues prioritized.  Data accessible on Internet.	2006  2007  2006-8	All States' watershed data is assembled into DR Basin clearinghouse.	3.1, 4.2, 1.1
3.3.B. Encourage and support <b>watershed communities</b> to work together on regional planning and growth management that will protect their shared water resources	Basin-wide and watershed assessments used for water resource protection and planning	2006	Multi-municipal plans adopted.  Watershed-based growth management embraced by states and communities.	3.1

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
			Water resource improvements. Number of Stormwater Plans amended.	
3.3.C. Ensure <b>availability and use of land and water resources data, analytical tools and models</b> to guide local and regional land use and growth management planning and decision making.	Data, tools & models on the internet.  Instructional workshops offered.	2007	Watershed communities use available data and tools to assess alternative development scenarios.  Communities incorporate conservation design ordinances.	3.1
3.3.D. Adopt and implement at local and watershed communities level, <b>comprehensive plans, ordinances, incentives or other tools</b> that incorporate scientifically sound and legally implementable provisions for the protection and enhancement of water resources. States to support & encourage; local & county government to implement; private and non-governmental organizations to partner.	Water resource protection measures are incorporated into all scales of planning and development, including public water supply and wastewater treatment.	2007	No change in water quality except improvement towards natural conditions. (baseline 2002)	3.1
3.3.E. Include <b>integrated water resource elements</b> in local, multi-municipal, regional, and state agency and authorities' plans, regulations, and decision-making processes.	Concurrent planning for water and wastewater infrastructure.  Coordination among water resource agencies, environmental programs and community planning.	2007	Integrated water resource issues are addressed through coordinated planning efforts with all water resource regulatory entities.	3.1
<b>GOAL 3.4 DEVELOPMENT, REDEVELOPMENT &amp; WATER RESOURCES</b>				
3.4.A. Identify and prioritize areas that would benefit environmentally and economically from <b>redevelopment</b> , taking into consideration water supply and	Appropriate areas identified and prioritized for improvements	2004	Redevelopment will be located in appropriate, targeted areas.	3.2

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
wastewater infrastructure capacity.	and redevelopment.			
3.4.B. Develop <b>criteria and incentives</b> to be applied during coordinated review processes that facilitate development and re-development consistent with the goal.	Incentives and criteria for review are established.  A coordinated review process is implemented	2005	Incentives encourage growth in areas with adequate infrastructure.	3.2
3.4.C. Develop <b>criteria and disincentives</b> to be applied during coordinated review processes that discourage development, and redevelopment inconsistent with the goal.	Disincentives and criteria for review are established.  A coordinated review process is implemented	2005	Disincentives encourage growth in areas with adequate infrastructure	3.2
<b>GOAL 3.5 STRENGTHEN CONNECTIONS TO WATERWAYS</b>				
3.5.A. Encourage <b>waterside re-development</b> , that emphasizes public access and aesthetic, historic, recreational and cultural values.	Waterside redevelopment areas prioritized.  Public investment in infrastructure improvements as necessary to support redevelopment.  Public-private partnerships established for urban waterside redevelopment projects.	2005  2007  2007	Abandoned waterside properties are revitalized. # acres?  Public access, cultural, historic, recreational and educational design elements are emphasized for the community. # ordinances adopted?	2.2, 3.1, 3.5
3.5.B. Create <b>waterway transit</b> opportunities for residents, commuters and visitors.	Assessments of transit opportunities.  Public and private investment in waterway transit. modes	2005  2008	Greater appreciation of river by users.  Reduced congestion on bridges and roads.	3.5
<del>3.5.C. Establish activities that connect people to waterways to encourage stewardship.</del>				Add to KRA 5

## Key Result Area 4: Institutional Coordination and Cooperation

*There would be obvious advantages to bringing a unified political control over the management of a single ecosystem [or bioregion]...In the latter part of the twentieth century it appears more feasible to seek close cooperation among the agencies involved in management of a bioregion than to attempt the redrawing of political maps.*

~ R. F. DASMAN 1995: *Bioregion*. In *Conservation & environmentalism: an encyclopedia*.

**Desired Result:** Strong, institutionalized partnerships for the management of water resources among all levels of government, the private sector, non-governmental organizations, and individuals that have an interest in sustainable water resources management.

**What does this mean?** Integrated management requires that all the related aspects of the water resource be considered in decision-making at many levels and within many jurisdictions. Successful implementation of this Plan will require a high degree of coordination and cooperation, including:

- *Horizontal integration*
- *Vertical integration*
- *Partnerships institutionalizing these relationships*

### ASPECTS OF WATER RESOURCES

#### INCLUDE:

- supply and demand
- quality and quantity
- surface and ground water systems
- potable supply and wastewater infrastructure management
- the dynamic relationship of water and land resources at the water's edge and throughout a watershed system.

### **Why is it important to institutionalize coordination and cooperation?**

Historically, water resources management has been fragmented, with different agencies and multiple players working on their own programs and agendas – often redundantly, sometimes at cross-purposes, and usually on single issues. We now understand the need for integrated management, coordination, and collaboration. This Basin Plan is itself the product of a collaborative planning effort among a wide range of Basin stakeholders. While it is clear that an integrated approach to managing our water resources is important, achieving and sustaining the necessary level of coordination and cooperation among the Basin's many decision-makers and other stakeholders requires that relationships among partners be reflected institutionally – in the way we make decisions and “do business” on a daily basis.

**Horizontal integration means coordinating actions and programs among actors operating within a level of jurisdiction.**

- **External:** Where two or more agencies at the same jurisdictional level have responsibility for an aspect of water resources, there is a need for consistency in the application of policy. For example, the agencies responsible for floodplain and stormwater management need to work together to achieve a uniform policy message and outcome.
- **Internal:** Departments within agencies must establish consistency among programs. For example, offices responsible for wastewater management plan approval, water allocations and facility permitting need to coordinate plan and permit review requirements. This will result in more comprehensive oversight of water resource use and can lead to streamlined review processes and greater efficiency overall.

**Vertical integration involves the alignment of efforts at various decision-making levels to achieve consistent outcomes.**

- For example, when the Federal government sets minimum standards pursuant to the Safe Drinking Water Act, the states must adhere to these federal standards (unless they adopt more stringent ones), and regional and local jurisdictions must apply these standards when exercising their permitting or management authority.
- Stormwater and flood management represent another far more complex example. Stormwater involves issues of quality, quantity and timing for which policies, plans, regulations and permits must be developed and approved. Flood management shares a concern with timing and quantity, but involves event forecasting and response activities, mitigation planning, and inspection activities to protect loss of life and property. The variety of concerns associated with stormwater and flood management is mirrored in our institutionalized approaches. In many cases, there is little coordination among flood management and stormwater management programs. The box below is suggestive of the distribution of authority for stormwater and flood management.

FLOOD (f) & STORMWATER (sw) MANAGEMENT RESPONSIBILITIES				
Policy	Planning	Regulation	Enforcement	Operational
FEMA - f State EMAs - f State DEPs - sw EPA - sw	FEMA -f Army Corps State EMAs Counties Municipal -sw, f	FEMA - f EPA - sw NRCS -sw State EMAs-f State DEPs – f, sw Municipal -sw State EMAs-f	FEMA - f State EMAs -f State DEPs SCDs - sw Municipal – sw	USGS - data Army Corps - projects State DEPs - inspections NWS - forecasting

F= Federal; EMA = Emergency Management Agency; DEP = Departments of Environmental Protection EPA = Environmental Protection Agency (federal); NRCS = National Resources Conservation Service (federal); NWS = National Weather Service; SDC = Soil Conservation Districts;

### ***The value of partnerships...***

Partnerships –play a critical role in fostering and solidifying integration management efforts. Partnerships offer:

- **A common focus:** attention on a common concern or a common landscape draws various interests together.
- **A level playing field:** in a partnership all participants – regardless of their authority, financial or political interests - all have an equal role in decision making.
- **Improved communication:** sectors that are often isolated from decision-making can have a voice in the decision process.
- **Information exchange:** partnership provide a forum for instantaneous information exchange and increase understanding of the environmental, economic and political consequences associated with the issue.

#### **COORDINATION AND COOPERATION ARE NEEDED TO...**

- Ensure consistency among state laws and state and local regulations, ordinances and plans.
- Support the integrated management of land and water resources.
- Enable multi-municipal approaches to address growth management and water resource issues in a watershed context.
- Support and implement watershed-based trading.
- Coordinate flood hazard mitigation planning and implementation.
- Coordinate recreational planning and facility development.
- Coordinate restoration activities.
- Control the spread of invasive species.
- Design and implement nonpoint source runoff controls.
- Support effective habitat conservation and protection projects.
- Support coordinated research, studies, and monitoring of streams to further our understanding of ecological processes.
- Develop and adopt integrated resource management plans.
- Accommodate both the rights of New York City under the 1954 Supreme Court's decree and the increased water flows necessary to sustain growth in the down-Basin states and to protect fisheries and ecosystems.



### Goals for Institutional Coordination & Cooperation

- 4.1 Improve coordination and cooperation in the management of water resources in the Basin.
- 4.2 Increase sharing of data, information, and ideas among Basin stakeholders and reduce duplication of effort.
- 4.3 Secure adequate resources for programs and projects that encourage cooperative water resources planning and management.
- 4.4 Ensure that water resource partners support and execute water resources management in accordance with the Guiding Principles, Goals and Objectives of this Basin Plan.
- 4.5 Utilize the planning and regulatory powers of a regional governmental authority, the Delaware River Basin Commission, to facilitate coordination and cooperation.

### **☑ Tasks and ⇨ Challenges**

#### **Goal 4.1: Improve coordination and cooperation in the management of water resources in the Basin.**

This goal cuts across all of the Key Result Areas encompassed by this Plan. There is no single “cookie-cutter” approach to improving coordination and cooperation among the many agencies, businesses, elected officials, not-for-profit organizations and individuals who play a part in managing the Basin’s water resources. For each area of research, planning, policy, management or decision-making this plan addresses (see box below), several steps must be taken to improve coordination and cooperation. The details of how to address each of the tasks and challenges described below will vary with the particulars of the area of planning or policy being addressed.

- ☑ **Define the “key players” whose efforts must be coordinated.** The list may include both Federal and state agencies, local units of government, business and industry players, research institutions, and citizen groups.

⇨ In identifying “key players” it is important not to neglect those stakeholders whose perspective may not be reflected by the existing decision-making structure.

⇨ Coordination must take place both as a collaboration across different areas of interest (the horizontal direction.), and as alignment within a single institution or hierarchy of institutions (in the vertical direction).

- 1 ☒ **Identify the relevant policies, laws, regulations and *planning* or permitting**  
2 **processes** which need to be better aligned, made more consistent, or otherwise  
3 coordinated.

4 ⇒ Conflicts among plans, laws, or regulatory regimes may reflect not just lack of  
5 communication but real differences in goals or objectives. This Plan and its guiding  
6 principles are intended to help overcome these differences.

- 7  
8 ☒ **Create a vehicle for collaboration that can bring the key players together.**  
9 Depending upon the “players” involved and the plans, regulations, or activities to be  
10 coordinated, this may take the form of a collaborative planning process with a  
11 defined objective and deadline; a technical working group which convenes  
12 periodically; an advisory committee which reports to a lead agency; etc.

13 ⇒ All the players may not be on an equal footing with respect to resources, and  
14 responsibility. In establishing partnerships or collaborative efforts, it is important to  
15 take into account the constraints and costs of individual contribution to ensure  
16 effective participation by all parties.

17  
18  
19 **Goal 4.2 Increase sharing of data, information and ideas among Basin**  
20 **stakeholders to foster partnerships and reduce the duplication of effort.**  
21

- 22 ☒ **Make information available in accessible formats.** Federal, State and regional  
23 agencies and non-profit environmental organizations collect a broad array of water  
24 resource-related data. This information needs to be made available in formats that  
25 can be readily interpreted for the purposes of implementing this Plan. Maps, for  
26 example, are easy to read and can be particularly useful for policy and planning  
27 purposes when associated with GIS spatial coverages that allow the overlay of  
28 other data.

- 29  
30 ☒ **Assess usefulness of collected data.** While some basic information is more or  
31 less straightforward to use as collected, other data – such as daily precipitation,  
32 stream flow, or monthly water quality reporting – are, in their raw form, of  
33 questionable use for policy and decision makers.

34 ⇒ Some data may need to be interpreted in order to be of significant benefit to  
35 users.

36 ⇒ The question of scale, discussed on p. X (KRA 1, p7), is critical to our  
37 understanding of water resource issues and to the measures we develop and  
38 employ to address them. Specific problems must be understood within their local  
39 context; regional or basin-wide context should also be taken into consideration  
40 during the evaluation of alternatives.

- 41 ☒ **Identify gaps as well as areas where data collection efforts overlap.**  
42 Partnerships may be able to help fill gaps in data collection or eliminate duplication  
43 of effort where data collection efforts overlap.

- 1  
2 ☒ **Provide a forum for discussion and analysis of available information.** There is  
3 a vast array of information, data, conjecture and misinformation available from many  
4 sources. Making sense of this information requires the opportunity to share,  
5 discuss, debate, learn and solve problems. Issue-based forums provide networking  
6 opportunities, forge partnerships, and enhance the stewardship of water resources.  
7  
8

9 **Goal 4.3 Secure adequate resources for programs and projects that encourage**  
10 **cooperative water resources planning and management.**

11 Always a necessity and a challenge, targeted, strategic provision of resources will be  
12 necessary to address the Goals of the Basin Plan. Challenges and ideas include:  
13

- 14 ☒ **Identify existing resources** that are or can be engaged in activities to implement  
15 the Basin Plan. Many state, regional, and local programs and activities are actively  
16 engaged in promoting, protecting, and enhancing water resources. An initial  
17 assessment of ongoing or planned activities and programs can be compared with  
18 Plan objectives to determine which issue areas will require special attention and  
19 cultivation of resources.  
20  
21 ☒ **Explore additional resource opportunities** to support investigation, monitoring,  
22 planning, assessment and implementation activities.  
23  
24 ☒ **Identify and increase opportunities to leverage federal and state funds** - for  
25 water resource planning, protection, and restoration.  
26  
27 ☒ **Create opportunities that encourage multi-jurisdictional approaches** -  
28 programs and projects that encourage cooperative water resources planning and  
29 management.  
30  
31

32 **Goal 4.4: Ensure that water resource partners support and execute water**  
33 **resource management in accordance with the Guiding Principles, Goals and**  
34 **Objectives of this Basin Plan.**

35 This Plan was developed with input from individuals representing Federal, State, and  
36 local government agencies, for-profit businesses and non-governmental, non-profit  
37 organizations. Implementation of this Plan will require the continued efforts of these  
38 partners ...and more.  
39

- 40 ☒ **Continue to engage a cross-section of Basin stakeholders** in implementing the  
41 Basin Plan. While the DRBC will have primary responsibility for collecting data  
42 relevant to measuring milestone and indicators, Basin partners will need to continue  
43 to provide input and oversight.  
44 ➡ The Watershed Advisory Council was convened as an ad-hoc body to provide  
45 the Delaware River Basin Commission with input on the development of a  
46 comprehensive Basin Plan. The Plan itself is non-binding, and there is no formal

mechanism established to continue the work of the Watershed Advisory Council or an equivalent body representing the various segments of the Basin community.

⇒ The 13,539 square miles of Basin territory is too large and its conditions too varied to effectively engage local participants on a basin-wide scale. Effective engagement of local contributors from the 838 municipalities, 42 counties, and myriad watershed associations is essential. Watershed regions, defined by grouping adjacent watersheds, perhaps those of the HUC 11 scale (see box KRA 1, p.7 and map p. X) offer a means of addressing local and regional issues and effectively engaging participation. Several regions have successfully organized for planning and action (see box).

#### WATERSHED PLANNING

There are many examples of successful watershed-scale planning & implementation efforts in the Basin. Among them are:

- *Schuylkill Watershed Conservation Plan*, 2001  
[www.schuylkillplan.org](http://www.schuylkillplan.org)
- *Final River Management Plan for the Upper Delaware Scenic & Recreational River*, 1986
- *Watersheds: Integrated Water Resources Plan for Chester County PA*, 2002
- *White Clay Creek and its Tributaries - Watershed Management Plan* – 1996

#### **Goal 4.5: Utilize the planning and regulatory powers of the Delaware River Basin Commission, to facilitate coordination and cooperation.**

- ☑ **Coordinate federal and state agencies within the Basin.** The Delaware River Basin Commission is a federal-interstate agency, established by Compact to manage water resources within the Basin. One purpose of the Commission is to coordinate the development of a common regional resource that, before formation of the Commission, was subject to uncoordinated administration by 43 state agencies, 14 interstate agencies and 19 federal agencies.
- ☑ **Manage water resources pursuant to a comprehensive plan.** The Compact authorizes the Commission to develop and adopt, after public hearing and with input from the states and their political subdivisions, a comprehensive plan for the immediate and long range development and use of the water resources of the Basin. The Commission should use its comprehensive plan to coordinate the goals and activities of government agencies and to guide and where appropriate regulate private activities.
- ☑ **Use the Commission's multi-faceted authority** to administer and assist other government entities in administering regional water resources in an integrated manner. The Compact grants the Commission broad powers in areas of water supply, pollution control, flood protection, watershed management (including soil

1 conservation and fish and wildlife habitats), recreation, hydroelectric power and  
2 surface and groundwater withdrawals and diversions.  
3

- 4 ☒ **Lead by example and guidance as well as through regulation.** The Commission  
5 should use its planning authority and leadership to educate, partner with other  
6 public and private entities and demonstrate how water resources can be wisely  
7 managed. Where coordinated efforts are important, the Commission should explore  
8 utilizing regulatory mechanisms such as setting performance standards that leave  
9 states, political subdivisions and private parties maximum flexibility in selecting the  
10 methods to meet the standards.  
11  
12

1

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
<b>GOAL 4.1 IMPROVE COORDINATION &amp; COOPERATION</b>				
4.1.A. Achieve <b>consistency in the implementation of water quality standards</b> that apply to the shared waters of the Delaware River Basin.	Development of a common set of water quality criteria for shared waters.	Baseline 2003. Assess every 3 years	Maintenance of water quality to meet criteria.	4.1, 1.2, 1.3, 1.4
4.1.B. Ensure at state boundaries that downstream state water quality standards are attained.		Baseline 2003. Assess every 3 years	Maintenance of water quality to meet criteria.	
4.1.C. Achieve <b>comparable monitoring, documentation and accurate reporting</b> of data that involves the basin-wide water resources of the Delaware River Basin	QA/QC protocols and reporting methods are compatible for water resource assessment purposes	2006	Smooth exchange of water resource data and information throughout the Basin	1.1, 1.2, 1.3, 1.4, 2.3, 4.1
4.1.D. Achieve consistency in <b>protection of public health in regard to consuming fish and shellfish</b> , due to chemical contamination, in regard to the shared waters of the Delaware River Basin.	Share data and monitoring results.  Consistent message to public for shared waters.  Public awareness program is implemented	2006		4.1
4.1.E. Achieve consistency in content and communication of <b>advice for primary contact recreational use</b> of shared waters.	System created for developing and communicating consistent advice regarding primary and secondary contact in shared waters to protect human health and safety.	2006	Advisories issued when necessary to protect human health (e.g., from bacteria) and safety (e.g., high flows and debris).	1.4, 4.1
4.1.F. For <b>future drought conditions</b> , improve exchange of hydrologic information, drought status reports, and drought restrictions among DRBC, States, and public	Continued refinement of drought indicators and reporting.	2003  2003	Up-to-date web page on drought conditions and restrictions.  DRBC and states set consistent	4.1, 1.1

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
			drought declaration & water use advice	
4.1.G. Foster communication among state and <b>local watershed programs</b> and processes	Uncomplicated exchange of information and data among local watersheds and state agencies.		Water resources information is easily accessible and current	4.1, 3.3
4.1.H. Improve coordination of stormwater management programs and practices.				
4.1.I. Encourage communication for water resource planning among the <b>watershed communities</b> and counties within a watershed	Integrated water resource plans are used as planning tools.			4.1; 3.3; 5.4
4.1.J. Improve coordination among State <b>coastal zone management</b> programs.	Basin Plan objectives incorporated into CZM programs			4.1, 3.4, 3.5
4.1.K. Improve coordination for <b>invasive species management</b> .				4.1, 2.3, 1.1
4.1.L. Evaluate and coordinate funding for <b>flood mitigation</b> .	FEMA, NRCS, Corps coordinate funding for compliance with Disaster Mitigation Act 2000.	2005-2010	Single source of information for federal flood mitigation funding.	4.1, 2.1, 3.1
4.1.M. Support and implement watershed-based trading, where appropriate, as a tool to complement traditional approaches to water quality management and improvement.	Pilot study determining need, opportunities, and potential constraints completed.  Pollutant trading ratios, project control measures and responsibilities suggested	2004-5  2005-6		
<b>GOAL 4.2 DATA SHARING &amp; MANAGEMENT</b>				
4.2.A. Complete framework data layers for the entire basin plus several other selected <b>GIS layers accessible via the internet</b> .	Completion of basin-wide database.	2004	# internet hits. User surveys.	4.2, 3.3
4.2.B. Make digital data layers and water-related <b>databases</b>		2006	# internet hits. User surveys.	4.2, 3.3

Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
available to view and download, integrated across political boundaries.				
4.2.C. Develop a <b>database of ongoing management activities</b> to foster partnerships and reduce duplication of efforts	Water resources programs and DRB network /clearing house is operational.	2006	Benchmark and pilot efforts are tracked and available for review.	4.2, 3.3, 5.2, 5.3, 5.4
4.2.D. Improve methods of <b>communication with and among local governments</b> on DRB issues and provide adequate opportunities for discussion of key issues				
<b>GOAL 4.3 SECURE ADEQUATE RESOURCES</b>				
4.3.A. Inventory existing resources and identify gaps to implement Basin Plan objectives.	Inventory completed.  All baseline tasks completed within timeframes.	1 yr. post-adoption.  3 year assessments, including resource availability	Effective and efficient range of funding sources that support water resource plans throughout the Basin.	4.3
4.3.B. Explore additional resource opportunities.		2004 baseline; 3-year reviews	3-year assessments of implementation, including resource availability	
4.3.C. <b>Increase opportunities to leverage</b> federal, state and other funds for water resource planning, protection and restoration.			Integration of Basin Plan activities with federal and state program funding.	4.1,
<b>GOAL 4.4 BASIN PARTNERS / PLAN IMPLEMENTATION</b>				
4.4.A. Create or enhance <b>formal partnerships</b> for the purpose of implementing the Basin Plan objectives.	MOUs, joint workplans, Commission resolutions.	2004 baseline Assess every three years from adoption.	# MOUs, joint workplans, and resolutions developed to implement Basin Plan objectives.  # Federal, state and local projects consistent with Basin Plan.	
<b>GOAL 4.5: UTILIZE THE POWERS AND AUTHORITY OF DRBC</b>				
Enhance DRBC Comprehensive	Basin Plan adopted	2004	State of Basin	4.5



Objectives	Milestone(s)	Date	Indicator(s)	Supports Goals
Plan to promote coordination and achievement of the Basin Plan objectives.	CP updated	2005-6	Report 2005  Tri-annual reporting on implementation progress.	

## Key Result Area 5: Education and Involvement for Stewardship

***Water links us to our neighbor in a way more profound and complex than any other.***

- JOHN THORSON

***The individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in the community, but his ethics prompt him also to cooperate (perhaps in order that there may be a place to compete for). The land ethic simply enlarges the boundaries of the community to include soils, water, plants and animals or, collectively: the land.***

~ ALDO LEOPOLD ***Land Ethic***, 1949

**Desired Result:** People of the Basin share a collective understanding and appreciation of the Basin's water resources and a commitment to the restoration, enhancement, and protection of those resources. People value the water resources and understand their personal responsibilities needed to protect the resource.

***What does this mean?*** The protection and prudent use of the water resources of the Basin depends on each and every resident, each company, and every organization that is involved with activities related to or relying on water. The four elements of water resource education for stewardship are:

- Water resource awareness
- Personal stewardship
- Professional training
- Engagement

### ***Why is education for stewardship important?***<sup>1</sup>

A basic premise of water resource stewardship is that we must learn two things - that we live in a watershed and that we understand how to live within the limits of our water resource system.

---

<sup>1</sup> This section is based on a description of watershed stewardship programs found in *Rapid Watershed Planning Handbook*, 1998, published by the Center for Watershed Protection, Ellicott City, Md.

**Water resource awareness is fundamental to the concept of stewardship.**

- Raising and promoting basic awareness and an understanding of water resources gives people the tools to investigate avenues for change.

**Conveying a sense of personal stewardship inspires personal action.**

- Educating citizens about the individual roles<sup>s</sup> they play in water resource stewardship communicates specific messages about positive and negative behavior, inspiring personal action.

**Professional training creates better educated decision-makers.**

- Many of the important choices related to water resource stewardship are made by decision-makers in the private and public sectors.
- Professional training for stewardship includes educating decision-makers about opportunities for the application of water resource protection tools, operations management for pollution prevention, maintenance methods, etc.

**Engagement requires opportunities.**

- An important part of education for stewardship is providing individuals, corporations, government officials, and other stakeholders opportunities to actively engage in protection, outreach and restoration activities.

**Goals for Education & Involvement for Stewardship**

**5.1** Establish a basin-wide sense of place.

**5.2** Increase student and youth awareness of, understanding of, and active participation in water resources issues through the widespread introduction of special curricula and other educational activities in schools throughout the Delaware River Basin.

~~**5.3:** Increase citizen awareness of, understanding of, and active participation in water resources issues. Objectives support Goal 5.1~~

~~**5.34:** Increase private sector awareness of, understanding of, and active participation in water resources issues.~~

~~**5.45:** Increase local public officials' awareness of, understanding of, and active participation in water resources issues, needs and management strategies.~~

1 **✓ *Tasks and ⇒ Challenges***

2  
3 **Goal 5.1: Establish a Basin-wide sense of place.**

4 Create a sense of connection between residents, businesses and officials and their  
5 watershed communities, as well as a sense of the place of that watershed within the  
6 Basin's water resource system.

7  
8 **✓ Motivate Basin residents, businesses and officials to identify with their**  
9 **watershed address.** Create awareness and understanding of the River and its  
10 watershed resources such that citizens, businesses, and officials are motivated to  
11 describe their homes, places of business, and communities in terms of their  
12 watershed address.

13  
14 **✓ Motivate Basin residents, businesses and officials to take responsibility for**  
15 **their behavior with respect to watershed resources.** Creating awareness and  
16 understanding of the River and its watershed resources should encourage citizens,  
17 businesses, and officials to change behavior in ways that help protect and restore  
18 our watersheds.

19  
20  
21 **Goal 5.2: Increase student and youth awareness of, understanding of, and active**  
22 **participation in water resources issues through the widespread introduction of**  
23 **special-watershed curricula and other-educational-related activities.**

24 We must take several steps to offer age-appropriate activities and curricula about water  
25 resources to the next generation of decision-makers.

26  
27 **✓ Develop curricula on resource issues of the Delaware River Basin.** An  
28 integrated, sequential, K-12 science curriculum focused on the Delaware River  
29 Basin and emphasizing service in partnership with the community would provide  
30 districts and educators with one of the tools they need to expand water resource  
31 education in our schools.

32  
33 **✓ Provide outdoor experiences to engage students in learning about the**  
34 **watershed.** Nothing makes a watershed lesson more fun and interesting than  
35 actual participation in an outdoor experience when theory becomes alive and  
36 engaging. Students can learn about important water resource educational elements  
37 by applying science concepts directly to a local watershed, monitoring their local  
38 watersheds through field studies, learning about the impacts of water resources in  
39 their communities, and restoring watersheds through community needs-based  
40 projects.

41  
42 **✓ Support educators by providing information.** A web-based clearinghouse can  
43 provide timely, local aspects on water resource issues useful for curricula and  
44 activity development.

**Goal 5.3: Increase citizen awareness of, understanding of, and active participation in water resources issues.**

Water resource management requires an active and informed citizen commitment – to participate in local watershed activities and to make “water smart” lifestyle choices.

- ☑ **Expand the use of web-based and mass media resources.** Linking existing sites from a central homepage is an approach the DRBC already uses in conjunction with other agencies and organizations in the Basin.

⇒ Enhance capabilities and expand information coverage to facilitate the acceptance and implementation of the Basin Plan. See also KRA 4, Goal 4.2.

- ☑ **Employ mass media coverage of water resource issues to further expand outreach.** The mass media will play an important role in educating the public about water resource issues and the importance of conservation and other good practices. Workshops for reporters, editors and other media professionals can play a critical role in ensuring the dissemination and consistency of important messages.

⇒ Projects that rely on volunteers, such as streamside restoration and planting, need to be advertised well in advance; print and radio media are critical elements.

- ☑ **Establish a basinwide clearinghouse and inventory** of watershed projects, programs and contacts as a means of creating a more formal link among non-governmental groups involved in water resource issues.

- ☑ **Expand participation opportunities.** Expanding the number of projects, activities, and programs in which citizens can participate will increase the exposure of citizens to water resource issues and to the stewardship opportunities available to them.

⇒ Successful expansion of participation opportunities must include an appreciation for the increasing ethnic diversity of the Basin. Outreach efforts should include minority populations and their interests and concerns about water resources. Messages about lifestyle management must reflect sensitivity toward cultural and religious practices.

- ☑ **Implement a signage program.** Providing geographic reference to streams and their drainage systems for the Delaware River Main Stem and all major tributaries that cross interstate and state highways can help convey the message: *“It’s your/my/our watershed!”* Signs telling motorists they are entering a particular watershed are already beginning to dot roadways. This “watershed addressing” technique educates visitors as well as increasing residents’ awareness of where they live and travel in relationship to their home watershed and to other watersheds in the Basin.

*If people can become familiar with the conditions for life and the other living species in the area in which they live, presumably they will be equipped to exercise greater care in the use they make of their bioregion, and they may take greater interest in protecting its natural diversity. A knowledge of ecological constraints...could prevent the kind of misuse of land, water and resources which has caused serious ecological damage in many parts of the world...*

~ R. F. DASMAN 1995: **Bioregion** in *Conservation & environmentalism: an encyclopedia*

**Goal 5.4: Increase private sector awareness of, understanding of, and active participation in water resources issues.**

Water resource protection and enhancement is a salient business issue.

⇒ The challenge is to create opportunities to form and firm the partnerships that will produce positive results in water resource issues and sustain the commerce in the Basin.

☑ **Encourage private businesses to adopt water resource stewardship as a part of their mission.** A long-term corporate commitment to stewardship protects the water resources for future generations in many ways. While adopting water resource-friendly policies at physical plant and office locations, corporations can advise their customers on how to handle or operate their products and changes in any regulations that may occur. The private sector can also partner with non-profit and local associations to promote community water resource programs.

☑ **Disseminate information about water resource issues to the commercial community,** describing water resource linkages with these entities' products and properties, and suggesting partnership opportunities.

☑ **Highlight demonstration projects** that showcase innovative and progressive commercial projects. These models may serve as examples for other private sector interests as well as good public relations for water resource management.

**Goal 5.5: Increase local public officials' awareness of, understanding of, and active participation in water resources issues.**

As has been emphasized throughout this Plan, better local land use decisions are the key to protecting water resources. Most of these decisions are made by public officials at the county and municipal levels. Outreach to these officials is critical, because state and federal regulations do not and can not provide a range of protection measure adequate to address the impacts of land management decisions on water resources.

1    ☒ **Target elected officials and local leaders for education and assistance.** Local  
2 leadership is absolutely necessary for local action. Leadership within the decision-  
3 making process can be especially effective in forging the critical link between land  
4 use and water resource management.

5       ⇒ The watersheds of the 13,539 square-mile Basin include all or portions of 838  
6 towns, township, boroughs and cities in 42 counties.

7       ⇒ The political and legislative structure of three states and a commonwealth dictate  
8 differences in roles, responsibilities and authority among those entities.

9       ⇒ Political cycles determine changes in community management occurring with  
10 great frequency – potentially every one to four years. It will require an especially  
11 dedicated commitment to provide education and technical resources as each new  
12 team of officials and leaders takes its place.

13  
14   ☒ **Provide technical assistance to watershed communities.** To incorporate  
15 changes in land use plans and regulations, watershed communities require  
16 technical information that is scientifically sound and legally defensible. Broad-based  
17 information about the role of planning in water resource management is a critical  
18 element of this education and outreach.<sup>2</sup>

19       ⇒ Generally, communities are very hesitant to take action on an issue if it would  
20 leave them vulnerable to legal action. Education and assistance programs must be  
21 developed to address this.

22       ⇒ Water resource protection needs to be easy and relatively effortless for  
23 successful local adoption and application. Model ordinances can facilitate this.

24  
25   ☒ **Foster partnership and communication among communities within each**  
26 **watershed.** It is important for each jurisdiction to understand its role within a  
27 watershed. (See KRA 3 for a discussion of “watershed community.”) Watershed  
28 communities should be encouraged to share information, collaborate on similar  
29 issues and agree on desired water resource outcomes. Non-profit organizations  
30 such as local watershed alliances can help to facilitate this collaboration.

31  
32   ☒ **Address the upstream and downstream roles of the community as part of**  
33 **outreach to public officials.** Programs to educate and encourage stewardship  
34 among public officials should help them to understand where their community fits  
35 into the larger picture of the watershed, and where their watershed fits into the  
36 Basin.

37       ⇒ Most officials have a good understanding of the political landscape in their county  
38 and state. The ‘water-scape’ needs to become just as salient if we are to  
39 accomplish improved water resource results.

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<sup>2</sup> See “The Only Real BMP That Really Works: Better and More Planning” Soap Box Editorial #1, July 2002, NEMO Nonpoint-source Education for Municipal Officials.

- 1 ☒ **Make funding and other resources available for watershed communities to**  
2 **prepare and implement water resource-oriented plans and ordinances.**

3 Making resources available with a minimum of fuss and hassle can make a big  
4 difference at the local level. A dedicated fund to improve the water IQ of local  
5 decision-makers would be especially valuable and practical.  
6  
7

8  
9 ***We are still in transition from the notion of man as master of the earth to***  
10 ***the notion of man as part of it.***

11 - WALLACE STEGNER



1

Objectives	Milestone(s)	Date	Indicator(s)	Support s Goals
<b>GOAL 5.1 ESTABLISH A BASINWIDE SENSE OF PLACE.</b>				
5.1.A. Create awareness and understanding of the River and associated resources so that citizens, businesses and officials are motivated to describe their home or place of business in terms of their watershed.	Establish mechanisms on education and involvement to instill awareness of and pride in the basin.			
5.1.B. Create awareness and understanding of the River and associated resources so that citizens, businesses and officials are motivated to act in ways that help protect and restore the watershed.				
<u>5.1.C. Continue and expand the use of Internet and mass media resources to educate the public about water resources use, waterway corridor management, land management for water resources protection, institutional cooperation and coordination for water resource management, and education for water resource management and stewardship.(Old 5.3.A.)</u>	<u>More exposure of DRB topics and events in media.</u>  <u>Provide DRB focused PR workshops for Watersheds, state officials' conservation groups, etc.</u>	<u>On-going</u>	<u>Increased participation in water resource programs and activities.</u>  <u>Increased coverage of water resource issues in the media.</u>	<u>5.2, 4</u>
<u>5.1.D. Maintain a clearinghouse for information on local watershed efforts, such as river conservation plans, restoration and preservation efforts – and opportunities for financial and technical assistance.Old 5.3.B.</u>	<u>Web-based data base for watershed activity in the DRB</u>	<u>2005</u>	<u>More effective and efficient watershed planning efforts.</u>	<u>5.2, 4. 3.1</u>
<u>5.1.E. Make education and outreach a priority to achieve public awareness and personal involvement on behalf of the Basin and local watersheds. Old: 5.3.C</u>	<u>Regular educational and outreach releases to the media</u>	<u>2006</u>	<u>Increased requests from public about water resources.</u>  <u>Improved water quality.</u>	<u>5.2, 4</u>
<u>5.1.F. Increase participation in volunteer water resource projects and programs in the Basin. Old: 5.3.D.</u>	<u>25% increase of volunteers for Basin water resource projects.</u>	<u>2010</u>	<u>Tracking system for Basin volunteers &amp; projects.</u>	<u>5.2</u>
<u>5.1.G.Increase the number of</u>	<u>Tracking</u>	<u>2010</u>	<u>No. of projects.</u>	<u>5.2, 4.</u>

Objectives	Milestone(s)	Date	Indicator(s)	Support s Goals
projects, programs and <b>opportunities for citizen participation</b> in water resources management protection and enhancement by 25%. Old: 5.3.E.	system for DRB volunteers & projects in place  25% increase in opportunities for participation and in Basin volunteerism		No. of volunteers (as percentage of population?)	
5.1.H. <b>Engage under-represented populations</b> in DRB water resource issues and stewardship. Old: 5.3.F	Under represented groups included in planning, events, and promotions	2005	Diverse population participating at events, programs and in decision making	5.2
5.1.I. Implement a <b>watershed signage</b> program, for the main stem Delaware River and all of its major Tributaries, on all state and interstate highways in the Basin. Old: 5.3.G.	Signs for all sub-basins and major tributaries at road crossings & boundaries.	2004	Increased awareness of watershed boundaries in DRB.	5.2
5.1.J. Provide information to enhance the ability of citizen and community groups to participate in <b>restoration activities</b> on their property and in their local watersheds. Old: 5.3.H.	Distribution networks refined and operating		Improved water quality from non-pt. sources Increase in watershed activities.	5.2
<b>GOAL 5.2 YOUTH &amp; STUDENTS</b>				
5.2.A. Develop and initiate a strategy to incorporate <b>watershed curricula in the education standards</b> of the four Basin states	All school Districts & private schools integrate watershed material in curricula  Materials available for home schooling	2008	All students in Basin know their watershed address	5.1, KRA 4
5.2.B. Provide a <b>water resources related outdoor experience</b> for every student in the watershed before high school graduation	Every student in DRB will have a hands-on outdoor experience by HS graduation	2010	Students will know about water resources and land use	5.1
5.2.C. Continue to promote and expand school programs that <b>provide active participation in</b>	Every school district has an annual	On-going	Every school district has a watershed or	5.1

Objectives	Milestone(s)	Date	Indicator(s)	Support s Goals
<b>watershed protection, restoration, monitoring and awareness building.</b>	<i>Snapshot</i> -like event.  Science clubs have a DRB related project.		stream project.	
5.2.D. Maintain a <b>web-based clearinghouse</b> specifically for educators.	Expanded Ed-Web capacity and content	2005	Increased hits on Ed-Web	5.1
<b>5.4.3 PRIVATE SECTOR</b>				
5.4.A. Collect and disseminate to members of the <b>commercial community</b> information about water resources issues	Materials developed and distributed	2007	Private sector participation in water resource programs increased.	5.3
5.4.B. <b>Highlight demonstration projects</b> that provide technology and information transfer to commercial interests in the Delaware River Basin.	Private sector demonstration project in each sub-basin	2007	Improvement in local water shed. Copycat projects in DRB	5.3
5.4.C. Encourage private sector funding and participation in DRB partnerships, initiatives and enhancement endeavors.				
<b>GOAL 5.5.4 PUBLIC OFFICIALS</b>				
5.5.A. Provide <b>outreach and technical assistance programs</b> targeted at local public officials, professional staff and consultants.	Examples of watershed communities' innovative programs available.	2005	Local ordinances protect water resources b) watershed communities working together	5.4, 3.1
5.5.B. Work with local governments to identify small watersheds where <b>community-based actions are essential</b> to meeting DRB preservation and restoration goals.	Watershed communities are working on water resource issues.	2008	Watersheds management is at the local level	5.4, 4. 3.1
5.5.C. Work with watershed community officials and organizations, and <b>supply resources to develop effective water resource programs.</b>	Watershed communities are adopting and implementing effective programs.	2007	Watershed communities addressing shared concerns.	5.4, 4. , 3.1
5.5.D. <b>Enhance funding</b> for locally based programs that pursue restoration and protection projects	Increased availability of Federal, State and private funds.		Dollars available per annum. Average award per locality.	

## Glossary

The terms in this glossary are defined for their intended use and purpose in this Basin Plan. There may be other definitions for these terms, particularly where they are used for other planning or regulatory purposes. Additionally, there may be other terms in use to define these or similar concepts.

**adequate supply** – a supply that is dependable and sufficient in both quantity and quality to meet the requirements of its users, even through periods of drought. The term can be used relative to human needs or ecosystem needs.

**aggradation** – the long-term, persistent rise in the elevation of a streambed by deposition of sediment.

**algae** – chlorophyll-bearing nonvascular, primarily aquatic species that have no true roots, stems, or leaves; most algae are microscopic, but some species can be as large as vascular plants.

**allocation** – see *water allocation*.

**ambient** – describes the surrounding environment (especially temperature and pressure) of an object or experiment, in particular an environment which affects the object or experiment but is not affected by it.

**anthropogenic** – occurring because of or influenced by human activity.

**anti-degradation** – a programmatic term meaning actions taken to maintain existing uses and water quality in the nation's waters. The concept and policy was created by the Department of the Interior in 1968 and has been included in EPA's water quality standards regulation since 1975. The basic concept of anti-degradation is to promote the maintenance and protection of existing water quality, and protection of existing uses for all surface waters because it recognizes that existing water quality and uses have inherent value worthy of protection and preservation.

**aquatic ecosystem** – the living and non-living natural components of a stream or other water body.

**aquifer** – a water-bearing layer of soil, sand, gravel, or rock that will yield usable quantities of water to a well.

**assimilative capacity** – the amount of contaminant load that can be discharged into a water body without exceeding water quality standards or criteria. Assimilative capacity is used to define the ability of a water body to naturally absorb and use a discharged substance without impairing water quality or harming aquatic life.

**base flow** – sustained, low flow in a stream; ground water discharge is the source of base flow in most places. Base flow constitutes all the natural dry-weather flow.

**baseline tasks** – inventory, characterization, and assessment activities providing data that support management strategies and decisions.

**Basin** – the drainage area of the Delaware River and its tributaries. See also *Delaware River Basin*

**Basin transfer** – the transfer of water or wastewater into or out of the Delaware River Basin

**benthic** – refers to plants or animals that live on the bottom of lakes, streams, or oceans.

**bioaccumulation** – the biological sequestering of a substance at a higher concentration than at which it occurs in the surrounding environment or medium. Bioaccumulation is also the process whereby a substance enters organisms through the gills, epithelial tissues, dietary, or other sources.

**biological diversity** – an ecological concept that incorporates both the number of species in a particular sampling area (richness) and the evenness with which individuals are distributed among the various species.

**biological integrity** – the ability of an ecosystem to support and maintain a balanced, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region.

**BMP** – Best Management Practice – methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and non-structural controls and operation and maintenance procedures.

**buffer** – an area situated between two areas in possible conflict. The objective of establishing a buffer zone is to reduce the possibility of adverse impacts of land use upon water quality.

**channelization** – modification of a stream, typically by straightening the channel, to provide more uniform flow. Channelization is often done for flood control or for improving the drainage or irrigation of agricultural land.

**coastal zone** – the lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or whose uses and ecology are affected by the sea. *Coastal Zone* refers to the area under the influence or responsibility of state or federal coastal zone management programs.

**conjunctive use** – the coordinated use of surface water and ground water, which derives from the recognized interconnection between both resources.

**conservation pricing** – a schedule of water charges designed to encourage conservation by pricing water to reflect its scarcity and economic value.

**consumptive use** – the quantity of water that is effectively removed from the water supply because it has been evaporated, transpired, or incorporated into products, plants or animals due to anthropogenic practices. *(Note: this will be discussed further due to conflict among state definitions.)*

**criterion** – a standard rule or test on which a judgment or decision can be based. Water quality criteria are specific levels of water quality which if reached are expected to render a body of water unsuitable for its designated uses. Water quality criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish and aquatic life production, or industrial processes.

**Delaware River Basin** – the drainage area of the Delaware River and its tributaries. See also *Basin*

**degradation** – (1) a decline in the viability of ecosystem functions and processes; (2) geologic process by which streambeds and floodplains are lowered in elevation by the removal of material. Severe forms of non-natural degradation are associated with land disturbance and urbanization, including channel incision, down cutting, widening, and associated floodplain abandonment and habitat loss.

**ecological integrity** – the presence of structural, compositional, and functional characteristics throughout the natural range of variability for a particular ecosystem. Ecological integrity can be assessed by comparing biological, chemical, and physical structures and functions to those of unimpacted, least impacted or representative (“reference”) systems or sites within a region.

Ecological integrity requires both the integrity of the individual chemical, biological and physical components of the ecosystem, as well as integrity of the functional relationships among those components. Biological and hydrological integrity describe some of those important relationships. In assessing for the ecological integrity of an ecosystem or a region, it is important to address both biological and hydrological integrity.

**ecoregion** – an area of similar climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

**ecosystem** – the interacting populations of plants, animals, and microorganisms occupying an area, plus their physical environment.

**encroachment** - any physical object placed in the floodplain that hinders the passage of water or otherwise affects flood flows, such as fill, excavation, storage of equipment and materials, or buildings.

**environmental inventory** – identification and assessment of natural and human-related features of the land and hydrologic system, such as geology, land use, water use, demographics, habitat, plants, and animals that provide a unifying framework for making comparative assessments of the factors that govern water quality, water quantity, and biological conditions among study areas.

**erosion** – the process whereby materials of the Earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.

**estuary** – brackish-water area influenced by the tides where the mouth of a river meets the sea.

**eutrophication** – the process by which water becomes enriched with plant nutrients, most commonly phosphorus and nitrogen.

**evapotranspiration, ET** – a collective term that includes water lost through evaporation from the soil and surface water bodies and by plant transpiration.

**export** – water or wastewater originating from one watershed or basin, but ultimately discharged in another is termed an export from the sending watershed or basin.

- feasibility** – the level to which an appropriate and desirable action can be accomplished without having to overcome burdensome practical, technical or economic obstacles that would cause undue negative repercussions. The measure of feasibility necessarily changes over time and from one situation to another because it requires weighing the relative advantages and disadvantages of a proposed action.
- floodplain** – the relatively level area of land bordering a stream channel and inundated during moderate to severe floods.
- floodplain function** – the ability of riparian zones to convey and filter flood waters, dissipate flood energy, and provide in-stream and streamside habitat in the absence of encroachment or obstruction. Natural vegetative cover along stream banks and riparian land, riparian open space, strong floodplain regulations, and stormwater management enhance floodplain function.
- flow regime** – the magnitude, timing, duration, rate of change and frequency of flows.
- freshwater inflow needs** – the quantity and timing of freshwater delivery to an estuary which is fundamental to its health.
- GIS** (Geographic Information System) – a system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data. Spatial features are stored in a coordinate system (latitude/longitude, state plane, UTM, etc.), which references a particular place on the earth. Descriptive attributes in tabular form are associated with spatial features. Spatial data and associated attributes in the same coordinate system can then be layered together for mapping and analysis. GIS can be used for scientific investigations, resource management, and development planning.  
<<http://www.nwgis.com/gisdefn.htm>>
- greenway** - a corridor of open land that provides one or more of the following benefits: (1) protection and management of natural and cultural resources; (2) provision of recreational opportunities; and (3) enhancement of the quality of life and the aesthetic appeal of neighborhoods and communities. (USEPA definition)
- ground water** – in general, any water that exists beneath the land surface, but more commonly applied to water in fully saturated soils and geologic formations.
- growth management** – the deliberate public effort to induce, restrain, or accommodate development and redevelopment in any geographic setting. Growth management addresses the problems that can accompany growth through an integrated system of administrative, financial and regulatory programs.
- habitat** – the part of the physical environment where plants and animals live. Aquatic habitat includes all nonliving, or physical, aspects of the aquatic ecosystem. Some living components such as aquatic plants and riparian vegetation also provide structural habitat to aquatic biota.
- headwater streams** – the source and upper part of a stream. All first order streams that are delineated as a blue line on a 1:24,000 7.5 minute United States Geologic Survey quadrangle map; up to and including their point of origin, such as seeps and springs along with their adjoining riparian corridors (NJDEP definition)

**heat island** – the area of increased temperatures, and sometimes increased wind turbulence, that is formed over cities and other highly developed areas.

**High Value Water Resource Areas** – areas of the landscape determined to be of great importance – Basin-wide or locally – to the maintenance of quality and availability of water resources. *For more discussion, see page X.*

**hydric soils** – soils at or near the surface that are saturated (by flooding or high ground water tables) frequently and long enough to promote the development of anaerobic reducing conditions that affect plant growth and promote the establishment of erect (self-supporting) plants that prefer such soils.

**hydrological cycle** – the circulation of water from the sea, through the atmosphere, to the land, and thence back to the sea by overland and subterranean routes.

**hydrological integrity** – a condition under which streams actively function to transport, store and remobilize water, sediment, and nutrients in ways that provide for natural changes in fluvial landscapes and riparian habitats over time. Streams with hydrologic integrity have short-term fluctuations in flow and have annual water yields, annual mean flows, timing of peak and low flows, and magnitudes of peak and low flows that approach natural conditions.

**hydrological modification** – any alteration of the terrain which results in change in movement, distribution, flow or circulation of surface or ground water such as construction of dams, levees, channels, stream crossings or paving.

**impervious surface** – a paved or compacted land surface that prevents infiltration of precipitation through soils and into the ground water. Impervious surfaces exacerbate stormwater runoff, reduce water availability, contribute pollutants to water bodies, and short circuit the natural hydrologic cycle.

**imports** - water or wastewater originating from one watershed or basin, but ultimately ending up in another is termed an import for the receiving watershed.

**infiltration** – movement of water, typically downward, into soil or porous rock.

**instream flow needs** – use of water taking place within the stream channel (instream use) for such purposes as fish and aquatic life propagation, recreation, water quality improvement, hydroelectric power generation, and navigation.

**integrated management** – acknowledging linkages among topics or concerns and combining or incorporating this consideration in assessing options, and developing policy and management plans. *For application of the concept of integrated management in water resource management, see Basin Plan Guiding Principles (p. X) and related discussion in the narrative for each Key Result Area.*

**interstate waters** –those waters that form the boundary between two or more states; flow from one state into another state; or are tidal tributaries of interstate waters. The following are defined as interstate waters in the Delaware River Basin:

- The waters below the confluence of an interstate stream flowing into an intrastate stream (i.e., Neversink River below Clove Brook).



- The largest (as defined by drainage area) headwater stream to an interstate stream (i.e., East Branch Delaware River).
- The entire length of a headwater stream if any part of the stream is interstate (i.e., West Branch Delaware River).

***invasive species*** - any species that may aggressively and negatively alter the functioning of an existing ecosystem. Exotic invasive species include any non-native plant, animal, or other viable biological material that enters an ecosystem beyond its historic range.

***isochlor*** – the “salt front” or 7-day average location of the 250 mg/l chloride concentration; used in drought operations rules for reservoir releases and maintenance of flow objectives at key locations along the Delaware River.

***karst*** – a type of topography that results from dissolution and collapse of carbonate rocks such as limestone and dolomite, and characterized by closed depressions of sinkholes, caves, and underground drainage.

***mitigation*** – actions taken to avoid, reduce, or compensate for the effects of environmental damage. Among the broad spectrum of possible actions are those which restore, enhance, create, or replace damaged ecosystems.

***morphology, stream or river*** – the dimensions, forms and patterns of channels and landforms that were created by rainfall and runoff.

***natural flow regime*** – equivalent to a natural hydrograph, which shows the variation in stream discharge (or river stage) that would exist in the absence of any human alteration, over a specific time period. A natural flow regime is fully and optimally supportive of native biota and ecosystem functions.

***natural stream channel stability*** - a stream that over time (in the present climate) transports the sediments and flows produced by its watershed in such a manner that the dimension, pattern and profile are maintained without either aggrading or degrading (Rosgen, 1996).

***natural variability*** – refers to the variation or changes in natural systems that can be expected to occur under normal conditions. This variability can be measured in a variety of time frames. Between seasons, for example, there is a range of expected variation in temperature and precipitation. However, within the expected range of variability, more severe events can occur. Periods of extreme temperature and precipitation (or lack of precipitation) are inevitable over time and can stress natural and human-created systems. One challenge in managing water resources is to protect against disruption to human activity caused by extreme events (such as flooding and drought) while minimizing disruption to the natural systems.

***non-point source*** – a pollution source that cannot be defined as originating from discrete points such as pipe discharge. Areas of fertilizer and pesticide applications, atmospheric deposition, manure, and natural inputs from plants and trees are types of nonpoint source pollution.

***nuisance plant growth*** – overabundance of aquatic vegetation and algae usually resulting from eutrophication in a water body. Nuisance plant growth can cause fish kills, taste and odor problems in potable water supplies, navigation and recreation hazards, and water quality violations.

**nutrient** – element or compound essential for plant and animal growth. Common nutrients in fertilizer include nitrogen, phosphorus, and potassium.

**open space** – land or water areas in a mostly natural or undeveloped state, parkland, green spaces or greenways useful or appropriate for the preservation of rural character, ecologically sensitive areas, flora and wildlife or areas of scenic, historic and cultural value, or the prevention of potentially conflicting land uses. Such lands may afford public outdoor passive recreational opportunities. (Source: *Burlington County Open Space, Recreation and Farmland and Historic Preservation Trust Fund Rules and Regulations.*)

**performance standard** – a statement of general criteria that define a desired result without specifying the techniques for achieving that result. Synonym: *performance-based standard*.

**pesticide** – a chemical applied to crops, rights of way, lawns, or residences to control weeds, insects, fungi, nematodes, rodents, or other ‘pests.’

**point source** – a pollution source that can be defined as originating from discrete points such as pipe discharge, drainage ditch, tunnel, well, concentrated livestock operation, or floating craft.

**pollutant** – any substance that, when present in a hydrologic system at sufficient concentration, degrades water quality in ways that are or could become harmful to human and/or ecological health or that impair the use of water for recreation, agriculture, industry, commerce, or domestic purposes.

**pollutant load** – refers to a material or constituent in solution, in suspension, or in transport; usually expressed in terms of mass or volume.

**pollutant loading** – refers to the rate of transport of a pollutant load; usually expressed in terms of mass or volume per unit time.

**pollutant sink** – areas where pollutants such as sediment, nutrients, and bacteria accumulate and concentrate. Common pollutant sinks include depositional areas of streams and rivers, reservoirs, and storage or sequestration areas.

**public water supply** - under the Safe Drinking Water Act (SDWA) public water supply (PWS) systems are defined as those regularly serving at least 25 people or having more than 15 piped connections. Systems providing water to the public may be publicly or privately owned.

**range of variability** – an approach for setting stream flow-based river ecosystem management targets, derived from aquatic ecological theory concerning the critical role of hydrological variability, and associated characteristics of timing, frequency, duration, and rates of change, in sustaining aquatic ecosystems. (Richter et. al. 1997. *Freshwater Biology* 37, 231-249)

**recharge** – Water that infiltrates the ground and reaches the saturated zone.

**reclaimed water** – see reuse

**redevelopment** – the reuse of an existing structure or previously developed land.

**resilience** – means the ability to rebound or recover from stress and trauma. Resilience in a natural system is related to the proper functioning of its components and to the state of its diversity. Diversity is the degree of variation and interconnectedness within a plant or animal community. Generally, systems with greater diversity are more resilient. A mature forest is more diverse than a field of corn or a lawn, for example, and it is expected that a forest will recover from a prolonged drought with less damage than a non-irrigated farm field, orchard or lawn. One of the reasons to maintain diversity in natural systems is so that they can recover from extreme events and continue to provide their important functions.

**restore** - to re-establish, to an approximation of a reference condition, the chemical, physical, and biological components of an ecosystem that have been compromised by stressors such as point or nonpoint sources of pollution, habitat degradation, hydromodification, etc.

**restoration** – return of an ecosystem or a site to a close approximation of its presumed condition prior to disturbance. [source: EPA]

**retrofit** -

**reuse** - the terms "wastewater reuse," "recycled water" and "reclaimed water" are used to refer to water which, as a result of treatment, is suitable for a direct beneficial use. An example of this would be wastewater treatment plant effluent that is used directly for irrigation use, replacing a new withdrawal.

**riparian** – areas adjacent to rivers and streams.

**riparian zone** – three-dimensional zones of direct interaction between the terrestrial and aquatic ecosystems. Boundaries of riparian zones extent outward to the limits of flooding and upward into the canopy of streamside vegetation. Riparian zones contain a high density, diversity, and productivity of both wetland and upland plant and animal species. These areas have high water tables and support plants that require saturated soils all or part of the year.

**runoff** – that part of precipitation, snowmelt, or irrigation water that is transported to streams or other surface water by overland flow, tile drains, or ground water. It can carry pollutants from the air and land into receiving waters.

**sediment** – particles derived from rocks or biological materials that have been transported by a fluid or other natural process, suspended or settled in water.

**shared waters** - those interstate surface waters that form the boundary between two or more states. In the Delaware River Basin, shared waters consist of the Delaware River from River Mile 0.0 to River Mile 330.7, including the tidal portions of the tributaries, and the West Branch Delaware River from River Mile 330.71 to 330.71-7.1.

**source water** - an aquifer or surface water body from which water is taken either periodically or continuously for off-stream uses.

**Source Water Assessment Plan** – is a plan to assess the susceptibility of public drinking water supplies to pollution as part of the Source Water Assessment Program (SWAP) required of all primacy states by the 1996 amendments to the Federal Safe Drinking

Water Act. The assessment program is to be used as a basis for building voluntary, community-based protection efforts to ensure safe drinking water.

**standard** – State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. Standards include the designated use of the water body and the water quality criteria that must be met to protect the designated use or uses.

**stormwater runoff** – rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate lower than rainfall intensity. Runoff is often channeled onto adjacent land or through a drain or sewer system into water bodies. This includes the runoff from rainfall events and snowmelt. Runoff can cause water quality problems in receiving waters and/or physical changes to stream corridor morphology.

*suitable water quality* – **water quality that protects existing and designated uses.**

**surface water** – an open body of water such as a lake, river, or stream.

**solids, dissolved** – amount of minerals, such as salt, that are dissolved in water. Indicates salinity or hardness of water.

**solids, suspended** – also suspended sediment, dependent upon the sampling method. Particles of rock, sand, soil, and organic detritus carried in suspension in the water column. In contrast with solids or sediment that moves on or near the streambed.

**steward** – a careful and responsible manager of something entrusted to one's care.

**stressor** - any agent, cause or active power that causes physical, biological or chemical stress to an organism or system.

**sustainability** - refers to the use of a resource in a manner that meets current needs without compromising the ability to adequately meet future needs. *Sustainability* means making choices to use a natural resource base in a manner to ensure that yields in economic prosperity, social improvement, environmental quality and natural beauty will go on – tomorrow & forever – to be passed on to our children and to subsequent generations.

“Development is sustainable if it satisfies present needs without compromising the ability of future generations to meet their own needs.” Brundtland Commission, World Commission on Environment and Development. 1987. *Our Common Future* (“The Brundtland Report”). Oxford U Press, NY,NY.

**Total Maximum Daily Load (TMDL)** – the sum of the individual wasteload allocations (WLA's) for point sources, load allocations (LA's) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDL's can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

**toxic substances** – those substances, such as pesticides, plastics, heavy metals, detergent, solvent, or any other natural or man-made materials, that are poisonous, carcinogenic, or otherwise directly harmful to human health and the environment.

**unstable stream** – any stream that is unable to maintain natural hydrologic and hydraulic function (dynamic equilibrium) due to loss of balance between interrelated controlling variables. Instability is a loss of equilibrium associated with streambed degradation, aggradation or lateral channel migration. Causes include localized upstream changes in sinuosity,

slope, resistance of bed materials; increased flood frequency, magnitude, or duration; increase or loss of sediment transport capacity; floodplain development; stream channel confinement or widening; and loss of streamside vegetation or riparian buffers. Instability impacts habitat and biological function in streams.

**water allocation** – generally, a regulated withdrawal of water from a ground or surface source on the basis of total volume and/or rate of withdrawal. This term is also applied to designated amounts of storage in a reservoir, including amount to be released to protect fisheries and recreational uses. This is not to be confused with the terms *load allocation* or *waste load allocation* which are permitted discharges regulated as part of a TMDL. See *Total Maximum Daily Load*.

**water budget** - a water budget is an accounting of all the water inflow, outflow, and storage changes in a watershed. It describes and quantifies the pathways water takes as it moves through the hydrologic system, including precipitation, infiltration, run-off, evapotranspiration, consumptive use, recharge, etc.

**water quality-based trading** – watershed-based trading arrangements among point-source dischargers, nonpoint sources, and indirect dischargers in which the 'buyers' purchase pollutant reductions at a lower cost than what they would spend to achieve the reductions themselves. Sellers provide pollutant reductions and may receive compensation. The total pollutant reduction must be the same or greater than what would be achieved if no trade occurred. The U.S. EPA considers trading as an efficient, market-based approach to pollution reduction that encourages innovation in meeting water quality goals, with commitment to enforcement and compliance responsibilities under the Clean Water Act.

**water quality criteria** - numeric or narrative value designed to protect and support a designated use of a water body.

**water quality standards** - includes the designated uses, criteria, and anti-degradation policy that define the water quality goals of a water body.

**water supply** - this term is typically used to describe the sum of all water sources available for use. It can be understood in the context of balancing available water supply (what we have) with water demand (what we want). It is distinct from the term *Public Water Supply* which refers to a specific category of water use.

**water trail** - a continuous stretch of waterway for canoeing, including such amenities as special access points and informative signage.

**watershed transfer** – the movement of water or wastewater across a watershed boundary or divide from one (source) watershed for use within another (receiving) watershed.

**water resource considerations** - the aspects of water resources relating to their use, quality and value that should be taken into consideration in making land use and growth management plans and decisions. These aspects include, but may not be limited to: water supply availability; wastewater treatment availability and capacity; direct and indirect impacts to water quality; water use and its related impacts to hydrological and ecological systems; impacts upon High Value Water Resource Areas; recreational potential.

**watershed** – the total area above a given point on a watercourse that contributes water to its flow; the entire region drained by a waterway or watercourse that drains into a lake, reservoir or bay .

**watershed community** – the group of residents, landowners, businesses and the units that use, govern, and make decisions about resources and development within a watershed.

**waterway corridor** - a stream and the portion of its adjacent landscape that directly affects and is affected by its hydrology and ecology.

**wellhead protection** - involves the delineation of the area contributing water to the point of extraction (withdrawal) of ground water and steps taken to mitigate potential contaminant sources in that area. The development of wellhead protection programs to protect public groundwater sources from contamination was required of states under Section 1428 of the Safe Drinking Water Act. In most states the local adoption of wellhead protection measures is voluntary.

**wetlands** – those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, fens, and ephemeral ponds.

**wetland quality** - the level at which a wetland performs the natural functions that are ascribed to wetlands, including flood storage, filtration of potential pollutants and provision of habitat. Wetlands that optimally perform these functions, and/or provide habitat for rare or endangered species may be considered “high quality” wetlands.

**wildlife resources** – all undomesticated animals and fowl that utilize the water resources of the Delaware River Basin for drinking and cleansing.